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Finance for Scientific Research

THE publication by the Association of Scientific Workers in the *Scientific Worker* of the final draft of a memorandum on the financing of research, a preliminary draft of which has already been discussed in a leading article in NATURE (138, 51 ; 1936) focuses attention once more upon the provision of finance for, and organization of, research, and the arguments of the memorandum itself and the observations of the Advisory Council upon them deserve close study by scientific workers. A brief survey of the way in which the present position has developed appears elsewhere in this issue (p. 146). The comments of the Advisory Council on the scheme put forward by the Association indicate, indeed, complete agreement with the general thesis that there is need—and urgent need—for much greater application of science by industry. Disagreement with much in the memorandum is based on special knowledge of the difficulties to be overcome, for it is stated that some of the premises upon which the conclusions of the memorandum are based are incomplete and inaccurate.

In the first place, an explanation is given of the way in which Government expenditure on research is limited by the degree to which industry generally is prepared and able to apply scientific method and advance in scientific knowledge. Over a very wide field, though perhaps not necessarily the whole field of science, Government expenditure on scientific research will be largely abortive unless its results are ultimately used in industry, at least in its broadest sense. There are of course branches of research which the State cannot leave to the initiative of industry, such, for example, as work on the preservation and transport of food or the economical use of fuel and the work of the National Physical Laboratory on the application of exact measurement.

It is perhaps pertinent to refer here to one special field which has hitherto largely been left to individual initiative or voluntary support, namely, that of industrial psychology. The success which has already attended the work of the National Institute of Industrial Psychology, demonstrates the valuable service which research in this field can render not simply to industrial efficiency but also to health and safety in industry and in society generally. Work in these latter fields is of course also carried out by the Medical Research Council through the Industrial Health Research Board, with which the Institute has sometimes been associated. In spite of this, the position of the Institute is far from satisfactory. Lack of resources prevents it from pursuing promising lines of work, and the response to its recent appeal has been quite inadequate. Under such conditions the national importance of its work may fairly raise the question of State assistance or development on a much larger scale.

Allowing, however, for such exceptions, though even here the co-operation of industry is often invited and forthcoming, the Advisory Council holds that the worst way of attempting to secure increased expenditure by industry is to spend large sums of public money for its direct benefit in advance. If the importance of securing contributions from industry itself be conceded, the soundness of this view can scarcely be challenged. Indeed certain sections of industry might be in a healthier position had regard been had to this principle before according them the protection of tariffs.

The Advisory Council then proceeds to refute the assertion that fluctuating finance has been a main difficulty. While the Parliamentary Science Committee has probably overstressed the

importance of fluctuations in income—the real trouble is that the general average level of contributions is much too low—the Advisory Council appears to go too far in the other direction. Figures are quoted to show that the net estimates of the Department of Scientific and Industrial Research as laid before Parliament increased continuously from 1929 to 1937, apart from a slight decrease in 1931. The actual expenditure of the Department as given in its annual reports decreased continuously from £740,520 gross or £555,691 net in 1930–31 to £654,736 gross or £451,987 net in 1932–33, increasing again in 1933–34 to £664,482 gross or £476,877 net and thereafter continuously to its present level. These fluctuations cannot be described as violent, nor can they be dismissed entirely as negligible.

On this point, therefore, the difference in the views of the Advisory Council and of the Parliamentary Science Committee appears to be rather in degree than in kind.

As regards the substitution of a fund for a Parliamentary vote, the Advisory Council directs attention to the fluctuations which occurred before the exhaustion of the Million Pound Fund, and deprecates the validity of this argument for replacing a vote by a fund. There is much better ground, however, for criticizing the proposal that the control of the funds for research to be provided by the Exchequer should no longer rest in the hands of the Lord President as minister responsible to Parliament, but in an autonomous body with the Development Commissioners as its nucleus and containing representatives of the learned societies, the universities, medical and agricultural associations, etc. The main reason for employing a minister responsible to Parliament and advised by Government research councils, the members of which are selected on the basis of knowledge and experience as distinct from interests, is the necessity of obtaining a proper balance of research expenditure as between industrial, agricultural and medical research. It is the minister's responsibility to satisfy himself that such a balance is maintained and to that end to submit proposals to Parliament.

The Committee is undoubtedly right in pointing out that Great Britain has lagged far behind Germany, the United States and the U.S.S.R. in providing institutions of this type. The Committee suggests, in particular, institutions for research in optics, silicates and fibres, while chemical engineering, particularly in problems of materials and unit operations, is a yet further field where a called for. Institutions of this type would largely be concerned with the long-range or fundamental type of research, and there is no reason to assert, as the Advisory Council does, that, if a vigorous industrial policy in industry is provided, coupled with steady pressure from the Government, they will yield results greatly in advance of the capacity of industry to utilize them.

The Committee then returns to its former contention regarding the fluctuating income for research. It is of course desirable that research should be free to develop without violent fluctuations, and particularly that it should be pursued vigorously in time of depression, when in the past it has been liable to be curtailed. The point is, however, in our opinion insignificant compared with the raising of research contributions from all sources to a really adequate level. Moreover, one of the most important needs of to-day is the consideration of the utilization of research resources from the widest possible point of view. This will almost certainly involve the re-distribution or re-orientation of research effort.

It appears to us, therefore, that the Committee's strongest comments on the Advisory Council's report are its silence on this question of the need for greater co-ordination and on the extension of scientific research into fields which at present make little or no use of it. It is not really possible to separate the two aspects of the problem—the planning or co-ordination and the financing of research. More adequate provision for the finance of research is not more needed to-day than better provision for a really wide view of the national efforts and resources for research with a view to their better distribution, particularly between the physical and the social sciences.

It is probable indeed that this question will be an early consideration of the new Division of the British Association. What will then remain is the question of the authority which can give effect to any recommendations coming from such an influential and representative source. We find no evidence in the present report that the machinery now in existence is incapable of being developed or modified to meet this need without essentially changing its structure. It will be recalled that Sir Daniel Hall's proposal for a Planning Council, intended to pass a technical opinion on proposals submitted to the Cabinet or to Parliament, comparable with the Treasury review which is already provided, contemplates representation in the

Cabinet by the Lord President of the Council, and the ultimate enhancement of his status in the Cabinet.

This appears to us to be far more promising a line of development than that of the autonomous board proposed by the Parliamentary Science Committee. We regard it as essential that any great development on these lines in the expansion of scientific and industrial research should provide, not merely for adequate scrutiny in Parliament, but also for adequate discussion of the financial and technical details in the general sense by technical and professional bodies in general. Despite the excellence of the work of certain public utility corporations such as the British Broadcasting Corporation, the Electricity Commissioners or the Port of London Authority, it cannot be contended that this system provides adequate opportunity for discussion or debate in Parliament, or the information which renders possible informed discussion in the scientific and technical press or elsewhere.

It is no condemnation of the present system that in practice the vote of the Department of Scientific and Industrial Research is normally passed without criticism or debate. That may be merely an indication of the lack of interest which it should be the task of scientific workers to dispel. All the evidence in fact goes to show that the Department is increasingly desirous of co-ordinating its work with that of the Medical Research Council and the Agricultural Research Council, and that the existing machinery should be reasonably adequate if used. Moreover, the Department has already proved its capacity to establish *ad hoc* institutions for special purposes where required as, for example, the Bridge Stress Research Committee, the Steel Structures Research Committee, and the Locomotive Experimental Station Enquiry Committee.

If, therefore, it is conceded that the Parliamentary Science Committee has not made out an entirely convincing case for the establishment of an endowment fund for scientific and industrial research, particularly for the institution of an autonomous authority, neither has the Advisory Council advanced convincing reasons why it should not stimulate research on a somewhat larger scale, and particularly by increased Government grants. It should be remembered that, as the report states, the total expenditure on all kinds of scientific research in Great Britain amounts to only about £4,000,000 a year, or much less than one tenth per cent of the national income, as compared with one half per cent in the United States and possibly one per cent in Soviet Russia. As has been pointed out from time to time, ultimately Government grants are provided by industry, and if industry is unable or unwilling to provide the required funds directly, increased Government support is merely an indirect means of achieving that end.

It is of course recognized that there are limits to Government effort in this direction, imposed no less by practice than by the educational position of industry as affecting its ability to utilize the results obtained. The field of work of a research association is by no means co-terminous with that of the research department of even the largest industrial firm. In the nature of things its work must be more generalized and less specific than that of an individual research department. On the other hand, a research association is well qualified to undertake the fundamental and long-range investigations which lie outside the scope or resources of even the largest individual research department, and it is precisely in this field that Government help is most desirable.

We do not suggest, of course, that fundamental or long-range research alone should be undertaken by the research associations, or that it is or should be exclusively their task. Much important work of this type is already undertaken by other Government research institutions, such as the National Physical Laboratory, and a strong case could probably be made out for a few more *ad hoc* research institutions. Moreover, such work belongs inherently to the universities also, and in this respect it is highly important that due regard should be had to all existing resources, particularly where, for example, as in chemical engineering, duplication involves the duplication of expensive equipment which may only be imperfectly utilized in any one centre.

Here is a particular case where co-ordination and planning appear to be called for and where some central authority might well on review find the increase in specific grants a sound policy. Never was it more essential to guard against sectionalism and to secure full flexibility if re-orientation and re-distribution are to be possible where required. It may well be hoped that the discussion of the report by influential associations as well as by individual scientific workers, may stimulate further attention to the national financing of research.

Science and its Applications in the Eighteenth Century

A History of Science, Technology and Philosophy in the Eighteenth Century
By Prof. A. Wolf. (History of Science Library.) Pp. 814 + 128 plates. (London: George Allen and Unwin, Ltd., 1938.) 25*s*. net.

THIS book is the successor of Prof. Wolf's history of science, technology and philosophy in the sixteenth and seventeenth centuries published in 1935, and is planned to form part of a complete history, to be extended in the future both backwards and forwards. The present instalment well bears out the favourable impression created by the earlier volume.

The arrangement of the work may be judged by a list of subjects with the number of pages given to each. Mathematics and physics occupy 297 pages; chemistry, geology and geography, 84; botany, zoology and medicine, 72; technology, 170; psychology, social sciences with economics, 78; and philosophy, 53. Thus it will be seen that most attention is given to the physical sciences and technology. This apportionment is perhaps justified by the relative advances made in the different subjects, and by the author's deliberate restriction of his account of philosophy to the supply of a philosophic background for eighteenth century science.

The book begins with an account of what the eighteenth century inherited from the sixteenth and seventeenth, and then gives a preliminary summary of what was accomplished in the eighteenth. "Enlightenment", born in England in the seventeenth century, spread to France and then to other countries. It involved the new idea of tolerance—freedom for every man to think what he wished and say it. It was believed that Voltaire and the Encyclopædists had established tolerance once for all in the world, to be developed more fully in the nineteenth century. If it were not true, it would be incredible that in the twentieth century half Europe has turned its back on tolerance and freedom, or allowed them to be suppressed by dictators.

The chief work of the eighteenth century in pure science was the acceptance and development of Newton's discoveries. They were spread in France at first largely by Voltaire; they underlay the most important articles in the French encyclopædia, and were carried many stages further towards the end of the century by Lagrange and Laplace. Mechanics and astronomy more and more confirmed Newtonian principles.

After a description of this work, Prof. Wolf passes to an account of observational astronomy, beginning with Bradley's unsuccessful search for annual parallax in the stars, which led as a by-product to the detection of aberration, and an estimate of the velocity of light. He then deals with other observations, the most important perhaps being the determination of the density of the earth by Maskelyne and Cavendish, and the very prolonged and extensive studies of stars, double-stars and nebulæ by William Herschel. From astronomical observation, it is natural to proceed to astronomical instruments, and here Prof. Wolf opens a subject often ignored in histories of science. Scientific instruments not only need great skill in their planning and manufacture, but also enable men to make discoveries and measurements which without them would be impossible. It needs but one example—the determination of longitude at sea by the invention of an accurate marine chronometer by John Harrison.

Next come chapters on the development of light, sound, heat and electricity and magnetism, in which perhaps the most interesting sections deal with Black's work on latent heat and the foreshadowing of the mechanical theory by the measurement of the heat developed in the boring of cannon by Benjamin Thompson, Count Rumford. In electricity, Coulomb established the law of attraction and, towards the end of the century, Galvani started the study of current electricity by observing the movement of frogs' legs when touched with two metals in contact.

In the early years of the century, chemistry was dominated by the phlogiston theory of combustion, chiefly formulated by Stahl. Here Prof. Wolf might have made the essence of the subject clearer. Phlogiston escapes when bodies burn, and, since there is an increase in weight, phlogiston must have a negative weight, a return to Aristotle's ideas. It was the work of Priestley, Cavendish and finally Lavoisier, that explained combustion in terms of ordinary bodies with positive mass and weight, and thus carried the fundamental principles established by Galileo and Newton in mechanics over into chemistry.

The work of Linnæus on systematic botany was followed by that of Wolff and Stephen Hales in plant and animal physiology, the latter subject being greatly influenced by Haller, whose eight-volumed book marked a new epoch. Medicine was developed by a line of medical men ranging from Boerhaave of Leyden to John Hunter of London.

Turning to technology, Prof. Wolf deals successively with agriculture, textiles, building, transport, power and machinery, the steam engine, mining and metallurgy, industrial chemistry, lenses, mechanical calculators and telegraphy. The list shows how wide is the scope of the book. Doubtless the description of these "practical applications" will appeal strongly to some readers.

The volume closes with chapters on psychology, the social sciences and philosophy, bringing an able and interesting work to a successful conclusion.

W. C. D. DAMPIER.

Stellar Dynamics

Stellar Dynamics

By Dr. W. M. Smart. Pp. viii + 434. (Cambridge: At the University Press, 1938.) 30*s*. net.

IN the year 1914, when the study of the movements of the stars was in its infancy, a monograph was published by Prof. (now Sir Arthur) Eddington in which was given an account and a discussion of what was known at that time of stellar movements and the structure of the universe. This survey, with its co-ordination of different lines of investigation, undoubtedly stimulated interest in the subject. In the intervening quarter of a century, investigations dealing with the many important problems connected with the movements and distribution have followed at a rapidly increasing rate. But until the publication of Prof. Smart's book, there has been no book in English to take stock of the position and to summarize what has been done.

The volume under review does not cover the whole field. It is concerned almost entirely with the movements of the stars, as may be inferred from the concise title. The related subject of the distribution of the stars receives scant attention. This is to be regretted, because the movements and distribution of the stars are so closely related.

The treatment in this book of the subject of the movements of the stars is mainly mathematical. The observational bases of many of the assumptions that are necessarily involved in a mathematical formulation are not discussed, and the results that follow from the mathematical analysis are not sufficiently compared with the data provided by observation. The Gaussian form of the general luminosity function, for example, is assumed, though it is well known that the observed luminosities show systematic deviations from the Gaussian law, and that the form of the luminosity function changes with galactic latitude. Again, the density distribution in the galactic system is represented by a formula of an analytical character, in which the density is determined by a single variable—the distance from the sun. Such representations of the density distribution were derived by disregarding or smoothing out real irregularities and are approximately valid only within a relatively small distance from the sun. It is now recognized that there are considerable fluctuations in the density distribution.

The statistical mathematical discussions are not without value and have played their part in the development of the subject. But their limitations are now clearly recognized. Analytical functions do not possess the degree of flexibility that is needed in dealing with the stellar universe, and consequently the analytical methods of the earlier investigations, elegant though many of them were, have largely been displaced by numerical methods. For these reasons, it seems to the present reviewer that many portions of Prof. Smart's book would have been of greater value if the treatment had been less mathematical and more closely related to observational data. In some respects, the book has appeared too late for the method of treatment that has been followed. Ten years ago, the objections to a purely mathematical treatment would not have been so strong.

After an introductory chapter, mainly concerned with an account of the data of observation, four chapters are devoted to the solar motion and the phenomena of star-streaming, the two alternative points of view—that of Kapteyn, of two intermingling streams of stars, and that of Schwarzschild, of a preferential direction of motion—being fully discussed. These chapters contain a good deal of rather heavy, but straightforward, mathematics, and might with advantage have been considerably compressed. The sixth chapter is devoted to the discussion of methods for deriving statistical parallaxes of the stars from their proper motions. This is an important matter, because the zero point for the period-luminosity relationship for the Cepheid variables must be derived from the application of the statistical method to the nearer Cepheids, and the whole scale of the dimensions of the galactic system and of the distances of the external galaxies depends upon the correct fixing of the zero point. There are many traps for the unwary in these statistical discussions, but Prof. Smart is a safe guide.

The space distribution of the stars is discussed in the next chapter, on the basis of one particular

hypothetical law for the density distribution. The mathematical superstructure is too top-heavy for the slender foundations and the results are not of great practical significance. No reference is made to star counts, which provide important information about the space distribution. It may be said that star counts are no concern of stellar dynamics, but neither, in the narrow sense, is the luminosity function, which is much used in this chapter. Star counts are intimately related both to the density distribution and to the luminosity function. In Chapter viii, general statistical methods of deducing certain frequency functions associated with various characteristics of the stars from other assumed frequency functions is discussed; the treatment in the main follows along the lines of the pioneer investigations of Schwarzschild.

A short chapter on moving and globular clusters is followed by three chapters dealing with the dynamics of stellar systems in general, galactic rotation and the dynamics of the galaxy. These chapters are the most interesting in the book, and contain a good account of the recent work of Oort, Lindblad and Plaskett on the rotation of the galaxy, as well as of the explanation of the preferential motion of the stars and the asymmetrical motions of the stars of high velocity. It may be mentioned that the approximate equipartition of energy among the stars is not referred to under the dynamics of stellar systems, and that there is no discussion of the information as to the time-scale of stellar evolution that can be derived from various dynamical considerations.

H. S. J.

Silva and Sentiment

Trees and Men

By Eleanor Hughes-Gibb. Pp. viii+171+11 plates. (London: Alexander Moring, Ltd., 1938.) 8*s*. 6*d*. net.

THE sentimental approach to a technical subject is unusual in modern times though common enough in books intended for the juveniles of Victorian days. In a work intended not for the expert, but rather to awaken the public conscience to the desirability of, and in some cases the necessity for, protection of our trees and forests, both at home and throughout the world, sentiment may play a useful part. In skilled hands it can be an effective instrument in a useful form of propaganda, providing it is supported by incontrovertible facts. Much of the information given in the book under review is taken from reliable sources and is pieced together with some skill, but it is unfortunate that many inaccurate or dubious statements have been allowed to stand. Thus, on p. 94, in reference to the cajuput forests of Cochin China, the following appears: "But more important is their invaluable property of absorbing the harmful germs of swamp fever in the soil in which they grow."

The book is divided into three parts, the first of which includes a justification of sentimentality, and such themes as trees of the Bible, tree worship and the economic value of trees. Economic products become "The Gifts of the Tree to Man" and the uncomfortable conditions of a treeless world are conjured up in a fantastic sketch. The second part deals with the manner in which mankind has used and abused these "gifts". Papermaking is given a chapter, which includes an account of the manufacture of pulp and paper and emphasizes the wastage that occurs in the non-utilization of damaged trees and the lop and top in the forest. Other products discussed include turpentine, rubber and maple sugar.

Several chapters are given up to afforestation in various parts of the world, emphasis being placed on the importance of forests in the conservation of water supplies and prevention of erosion as well as for the maintenance of timber supplies. Some striking examples are given of the devastation caused by forest fires, many of which could be prevented if the public were fully aware of the dangers. The third part, which is given a separate title, "The Life of the Tree", includes a description of the life processes of a tree that is misleading on account of numerous inaccuracies. For example, on p. 145, we are told that sugars are derived from "the carbon dioxide and the moisture of the atmosphere", and on p. 149 we learn that "The green chloroplasts take in the carbon dioxide through the 'stomata'". If the manuscript had been submitted to a competent botanist, such elementary mistakes could have been avoided and the numerous invalid and misspelt botanical names corrected.

The book is illustrated by photographs and by a number of drawings by Archdeacon Lonsdale Ragg, who with characteristic touch has caught the beauty and personality of his subjects. The fine avenue of beeches at Tarrant Gunville Manor, which provides the frontispiece, was drawn specially for the book, while the fine old Cedar of Lebanon at the Rookery, Streatham, will be recognized by many Londoners.

R. M.

Racial Fallacies

Lehrbuch der organischen Geographie: Vorschule und Einführung in das Studium. Von Prof. Ewald Banse. Pp. ix + 626 + 5 plates. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.) 18 gold marks.

THE author claims that his book marks an epoch in the supersession of mechanical by organic thought about the world. It would almost appear that the discovery that "Landschaft und Volkheit" should be treated together is claimed by him as his contribution to knowledge. Surely, not to go farther back, we all acknowledge our debt to Ferdinand von Richtofen and Paul Vidal de la Blache in this matter, the more so as we do not feel that Banse gets as far in that direction as they and others have done. Banse claims that he does not follow out details in the way that 'liberals' would, but makes the presentation of *Ganzheit* (wholeness) his aim. One could wish that he did this more carefully, but for that purpose some insight is needed that he clearly lacks. Looked at as a product of a mechanistic mind, the book has its value as a work of reference for its immense series of definitions. It is regrettable that the author should find it necessary to overstate his own claims, for example, to be the chief author of a system of major regions (1912), dismissing the Herbertson scheme (1905), as a timid effort.

The book begins with physical geography of the still or non-moving *Landschaft* and its evolution under the influence of endogenous and atmospheric influences, and the chief forms it demonstrates to us. One notes that the author includes in this section a review of the facts concerning rivers, lakes and seas, as well as a study of the earth's vegetation. He then proceeds to the moving *Landschaft* which, for him, includes the atmosphere and animal life. Already, in each of these sections, he includes some paragraphs about the relations of man and the various natural phenomena with which he deals. This element in his work would be more valuable were it not for a continual reiteration of the view that war is, apparently, the chief end of life. But that is in keeping with the fashion that the author seems to be so anxious to follow.

Much of the third chief section of the book is devoted to generalizations concerning *Rasse und Volk* as seen in the totalitarian State. A race is defined as a group within mankind which is distinguished from all others by its inalienable heritage of spiritual and corporeal qualities, and it is stated that it is to be distinguished from a 'folk', within which one finds examples of several races side by side or mixed. It is well to say that the earth's peoples practically all show diverse biological types living side by side. To assert that a supposed spiritual (or mental) heritage is inalienably attached to each corporeal type is pure speculation. This hypothesis is followed by the claim that the language and the energy of will of the Germans are derived from the Fälisch-Nordisch Oberrasse, which has thus given the spiritual, linguistic, cultural and national heritage to the people, but is unfortunately bound to live side by side with other 'races' in Germany. The author makes a special point of 1933 as the beginning of a great advance in the spiritual influence of this Fälisch-Nordisch Oberrasse. One would regret to ascribe to it the cruelties and oppression which have marked recent developments in Germany. Would it not be better to think of the liberalism and toleration so characteristic of the peoples of Sweden, Norway and Denmark as a Nordic feature?

To a Germanophile, these unfortunate characteristics seem rather an example of the mutability of psychological traits under social and political influences. As to the Fälisch-Nordisch idea, it is probably of little use to reiterate that the immense majority of the German people are broad-headed, and that most of the great figures of German life in the past are far from the Nordic type, even if we twist the facts of observation to suit a prejudiced outlook, and call Nordic anyone whose colouring is light. No mention is made of the services of German Jews to German culture.

In the matter of origins of man we find a restatement of the ideas of Klaatsch, which, it has long been understood, he abandoned before his death. The notions of a separate descent of man from perhaps even Palæozoic ancestors, of an infinite gulf in descent separating white men from Africans and so on, are all expounded in a not very skilled fashion, and unfounded claims about Fälisch-Nordisch origins of cultural features are implicit as well as explicit in many paragraphs.

The German people have a great tradition; their contributions to civilization have been outstanding in almost every field. It is to be hoped that German thought may yet recover from the petty vanities and prejudice that have affected so much of it in recent years.

H. J. F.

Enzyme Chemistry

Kurzes Lehrbuch der Enzymologie
Von Theodor Bersin. Pp. viii + 170. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 12.80 gold marks.

DR. BERSIN'S interesting book covers a very large field in a very small space and he is to be congratulated on the brevity, clarity and, on the whole, the accuracy of his exposition. The book is highly condensed, probably too much so for those with little acquaintance with the subject, and whilst general analytical or mathematical treatment is restricted to the barest outline, prominence is given to some of the remarkable advances which have been made in the field of enzyme chemistry during the last few years.

The subject-matter is divided into three sections. The first is concerned with the general properties of enzymes, the second (taking up about half the book) is concerned with the properties of individual enzymes, and the third has to do with a much too brief treatment of the parts played by enzymes in respiration, nutrition and metabolism.

Dr. Bersin's conception of an enzyme is a generous one. He includes in his classification such substances as cytochrome and flavoprotein. It is not clear what is his justification for this procedure, especially as he states that the activation of a substrate by an enzyme takes place only at certain suitable areas (*aktive Gruppen*) of the enzyme surface. One would like to know what substrate molecules are specifically activated by cytochrome or flavoprotein; there is no indication of their nature in Dr. Bersin's book. It is characteristic, however, of the state through which a certain section of enzyme chemistry is now progressing that prominence is given to the nature and functions of prosthetic groups (coenzymes) rather than to the specific proteins which are the actual activating agencies of the substrates that undergo change. This is entirely to be expected, for it is only recently that the chemical nature of these prosthetic groups has been elucidated. Yet there seems to be a definite danger that the significance of the special protein to which the substrate molecule is specifically attached is being overlooked; certain it is that the importance of the specific protein is at present overshadowed by that of the 'prosthetic group'.

Dr. Bersin deals shortly in the first section of the book with such topics as the protein nature of enzymes, enzyme reactions in heavy water, enzyme kinetics, optical specificity, temperature effects, enzyme formation in the cell and with some other topics relevant to a chapter on the general chemistry of enzymes. He has but little to say, however, on the recent work on adaptive enzymes, on the reversible inhibitors of enzymes, on the protective influence of substrates on their enzymes, and it is surprising that, in a text-book of this nature, details concerning enzyme equilibria (for example, with the dehydrogenases, fumarase, aspartase, etc.) are absent.

Dr. Bersin proceeds to deal at greater length with esterases (considered, however, very scantily), carbohydrases, amidases and proteases. Due prominence is given to the recent work on the crystallization of proteolytic enzymes, useful descriptive procedures are noted and care is taken to impress the reader with the importance of the thiol groups in the activity of papain. It should, however, be pointed out that Bergmann and Ross have shown that the activity of papain cannot be interpreted solely on a –SH, –SS–, basis. The section is terminated by chapters on carbonic anhydrase, carboxylase and the reduction-oxidation catalysts. These are fairly adequately treated considering the space at Dr. Bersin's disposal, but there are many omissions (for example, carrier linked reactions, amino acid oxidases) and there are several points where criticism may be directed.

Dr. Bersin states, for example (p. 124), that disulphide-thiol systems (for example, glutathione, cystine) act as hydrogen acceptors to the succinic acid dehydrogenase system. There is no evidence for the truth of this statement. Moreover, he states that succinic acid enters into an equilibrium with its dehydrogenase giving rise to fumaric acid and a reduced form of the enzyme. The latter is held to be not autoxidizable but to reduce cytochrome. Such a statement is at present without direct experimental support, and the text-book under review seems scarcely the place to make such a statement without some sound evidence to support it. A similar criticism may be directed against the inclusion (p. 119) of glyoxalase as a system consisting of two dehydrogenases, flavoprotein and another, unknown, factor.

Dr. Bersin's book would have been improved, especially for those for whom it claims to be a guide, by the inclusion of more references to original articles. The total number of references cited is just over a hundred, of which one third are references to review articles in the *Ergeb. d. Enzymforschung*. The book is well printed and free from typographical errors. J. H. Q.

Die Binnengewässer
Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten. Herausgegeben von Prof. Dr. August Thienemann. Band 16: Das Phytoplankton des Süsswassers, Systematik und Biologie. Von Dr. G. Huber-Pestalozzi. Teil 1: Allgemeiner Teil, Blaualgen, Bakterien, Pilze. Pp. v+342. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung. (Erwin Nägele, 1938.) 42 gold marks.

BRITAIN took the lead at one time in the making of big books of reference in botany and natural history; this was in the days, for example, of Bentham and of Hooker, of the *Challenger* Reports and of the British Museum Catalogues of Birds and of Fishes. But nowadays the Germans seem to have it all their own way, and here, drawing at last to a close, we have the sixteenth volume, or part of it, of the great work on "Die Binnengewässer", or what we have learned to call limnology, which the late Einar Naumann of Lund and Prof. Thienemann of Kiel began to publish a dozen years or so ago.

This last part, by Dr. G. Huber-Pestalozzi, deals with the phytoplankton, or so much of the fresh-water flora as floats or swims; and as the present volume includes neither the diatoms, nor the desmids, nor the Volvocineæ nor many more, there is still a deal to come. In fact we have here only the free-living bacteria and a few fungi and the blue-green algæ or Cyanophyceæ, with a hundred pages of introductory matter thrown in. The account of the Cyanophyceæ covers 150 pages and is very fully illustrated; as a compendium of many important genera, *Nostoc*, *Oscillatoria*, *Anabæna*, *Lyngbya* and the rest, it is all that could be reasonably desired. The introduction deals with many points of general interest. It divides the plankton into plankton proper and the so-called 'neuston'—a term new to us—which means the organisms the peculiar province of which is the surface-film; here various minute plants accumulate, here *Gyrinus* and *Ranatra* skate on top, and here *Scapholeberis* clings on below. A long chapter deals with *Schwebetheorie*, that is to say the conditions of magnitude, form and density which fit the organism for a floating life, and cause or help it to shift its place and depth according to time and season. Here Dr. W. Ostwald's well-known work, and that of other writers on the physical side, is duly dealt with; but this side of the case is by no means easy, and the author is more at home on the other.

Our Wandering Continents:
an Hypothesis of Continental Drifting. By Dr. Alex L. du Toit. Pp. xiii+366. (Edinburgh and London: Messrs. Oliver and Boyd, 1937.) 18*s*. net.

THE author is to be congratulated upon a brave project, the writing of a geological history of the earth in terms of continental drift. He has unrivalled credentials, based upon a special knowledge of South Africa, combined with comparative study of that sub-continent and South America, and with extensive travel in many other lands. His introductory chapters include useful summaries of the writings of Taylor, Baker and Wegener, to mention but a few. Then follows the Palæozoic and Mesozoic story of Gondwana and Laurasia, considered separately. The Carboniferous glaciations and *Glossopteris* flora of the former receive due consideration. More novel is a synthesis of the Samfrau geosyncline, named after South America, South Africa and Australia.

The subsequent history of the lands of the world as a whole is grouped geographically about the great double fold-girdle of Tertiary mountains, which in its southern loop embraces the scattered segments of Gondwana, and in its northern loop, those of Laurasia. Later chapters deal with such topics as oceans, the significance of chemical changes leading to condensation in depth, climatic changes, distribution of plants and animals, geodetic evidence, and, of course, possible causes of continental drift.

Readers should be warned in advance that they will find du Toit's book difficult to digest, and that they may feel affronted by uses that have been made of fragmentary evidence. On the other hand, it is to be hoped that they will have sufficient vision to be grateful to a courageous pioneer. E. B. BAILEY.

Botany for Fun
By Gareth H. Browning. Pp. xii+176. (London: Lindsay Drummond, Ltd., 1938.) 5*s*. net.

THIS delightful book is not intended as a text-book, but is designed to engage the interest of young readers in the study of plant life. With this aim in view, the author has adopted a unique style of writing which forces itself upon the reader so that he almost learns without thinking. Technical terms, though not altogether excluded, are relegated to the background, and though the style of writing is attractively conversational and non-scientific in the technical sense, no one would condemn the author for that. The teaching botanist would agree that such chapter headings as "Magic in the Factory", "Flower-Parents and their Children", "Adventuring into the Outer World" and "Family Gatherings" convey just the right shade of meaning to the child-mind.

It is very difficult to write in this style yet not stray from the path of scientific accuracy; but careful scrutiny shows that the author has succeeded in surmounting this difficulty. We are glad to see, for example, that the author writes of "food *materials* passing up from the roots to the leaves" and of the "stream of *manufactured* food" travelling from the leaves. He even goes so far as to emphasize the important words by using italics. Many botanical texts are guilty of erroneously referring to mineral salts, carbon dioxide, etc., as plant *foods* so that it is very difficult to teach children the essential similarity between plant and animal foods.

The illustrations are good and the interpolation of interesting historic episodes adds much of value to the whole.

Though the author emphasizes that this is not a text-book, we venture to suggest that it might with distinct advantage be adopted in classes of children of about eleven years of age.

(1) Unit Processes in Organic Synthesis

By P. H. Groggins (Editor-in-Chief). (Chemical Engineering Series.) Second edition. Pp. xiii+769. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 36*s*.

(2) Industrial Chemistry

By William Thornton Read. Second Edition. Pp. ix+605. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 25*s*. net.

THE very rapid development of the chemical industry in the United States, which country probably leads the world to-day in this respect, has brought about a demand for trained chemists both on the research and on the factory side. The magnitude of the profession is witnessed by the fact that the American Chemical Society has a membership of more than 21,000 and has enlisted more than 2,000 new members per annum for the last three years. It is becoming customary for students entering on the factory side to take a course in chemical engineering. It was stated last summer that rather more than half the chemical graduates do this. In consequence there is a demand for chemical engineering literature both of a general and a specific character, and to-day America is well served in this respect. The demand for such books enables them to be kept up to date, an important factor in a rapidly developing science.

Both these books are second editions, that of Groggins after four years. It deals with unit processes in the organic industries, many of the individual chapters being contributed by experts, as is now the custom. The new enlarged edition is likely to enhance the reputation of the work.

Read's book has likewise received expert criticism, the individual chapters having been sent to more than a hundred authorities in the particular fields. The sections relate to individual branches of the industry, a wide range being included. With these two books on his shelves the trained chemist is well equipped to tackle problems in any branch of the chemical industry.

Summable Series and Convergence-Factors

By Prof. Charles N. Moore. (American Mathematical Society, Colloquium Publications, Vol. 22.) Pp. vi+105. (New York City: American Mathematical Society, 1938.) 2 dollars.

THIS work is designed to give a systematic treatment of convergence-factor theorems, where these consist of results concerning the relationship between a definition based on mean-values and a formally distinct definition in terms of convergence-factors. For all the methods of summing divergent series in general use may be classified as either mean-value or convergence-factor methods, and to any method of either type, a formally equivalent method of the other type can be constructed. The range of validity of these methods is approximately the same in most cases; and where there is a difference, it will usually be in favour of the convergence-factor form.

Here, two types of convergence-factors are considered. Those of Type I have, as sole object, the maintenance and production of convergence; while those of Type II may be used to obtain the sum of a series. In this most instructive work, both types of convergence-factors are examined; and the theory is developed for multiple series of any order, as well as for simply-infinite series. By means of the use of the Nörlund, instead of the Cesáro means, the theory developed here is more general than that found in most of the available literature on the subject. Thus, many previous results appear here as special cases of the theorems proved—particularly in the third, fourth and fifth chapters.

A. v. Z.

Rezeptbuch des Alltags

Von Dr. Hermann Römpp. Auflage 3. Pp. 349. (Stuttgart: Franckh'sche Verlagshandlung, 1937). 8.50 gold marks.

THE word *rezept* is liberally interpreted, and this book includes prescriptions for dealing with all the problems that are likely to arise in an ordinary household. It gives directions for making emetics, hair dyes, shampoos, face creams, eau de Cologne, mouth washes, shaving soap, alcoholic drinks, boot polish and about ten kinds of ink, and for treating colds, warts, nose-bleeding, sea-sickness, heat-spots, sunburn and indigestion. Sections are devoted to the keeping of horses, cows, dogs and cats, and to getting rid of mice, rats, earwigs, ants, snakes and a host of other pests that afflict houses and gardens. There are sections on gardening, photography, food and clothes. The information appears to be accurate and up to date.

A Course of Physics

By Prof. Henry A. Perkins. Pp. ix+820. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1938.) 15*s*. net.

PROF. PERKINS, of Trinity College, Hartford, has written a text-book of elementary physics covering more ground than is usual. His aim has been to give the student a substantial grasp of physical principles rather than to describe phenomena. Simple algebra and trigonometry have been freely used because most students find a concise symbolic statement easier to grasp than a verbal one. Modern physical ideas have been treated as fully as is feasible in a course of this kind, and nearly eighty pages have been devoted to 'corpuscular physics'. The book should prove suitable for an intermediate science examination in Great Britain.

The Cradle of the North Wind

By A. S. T. Godfrey. Pp. xi+234. (London: Methuen and Co., Ltd., 1938.) 8*s*. 6*d*. net.

THIS charmingly naive book gives a glimpse of the fun which, according to the author, may be derived from roughing it in the Arctic and from killing its animals, always with the proviso that there is not too much "scientific nonsense" about. It must, however, be remembered that the penalty for a frivolous attitude of mind towards the polar regions is very likely to be death, and not for one's self alone: the ice is not suitable for a kindergarten. It is a little surprising that such a book should presumably have been sanctioned by the Oxford University Exploring Club.

J. E. HAMILTON.

The Sea-Bird as an Individual: Results of Ringing Experiments*

By R. M. Lockley, Skokholm Bird Observatory

SKOKHOLM ISLAND lies a few miles off the coast of Pembrokeshire. It is about 240 acres in extent, is entirely rock-bound, and has only two houses on it, a lighthouse at the most westerly point, and this is a mile from my own house on the east side of the island. The cliffs are of Old Red Sandstone, and there is a good thick soil on the greater part of the island.

I was attracted to the island in the first place by its great wealth of sea-bird life. Later, as opportunity afforded, I commenced to look into the individual lives of these birds. The first essential in such a study, since individual sea-birds of one species are more exactly alike than peas in a pod, was some method of marking. I adopted Mr. Witherby's scheme for marking birds with numbered leg-rings. This scheme has now been taken over by the British Trust for Ornithology and is housed in the British Museum (Natural History).

There are seven sizes of rings to suit all species of British birds from a wren to an eagle. Each ring has a serial number and the inscription "Inform British Museum (Natural History), London"; so that those who capture alive or find dead a bird with such a ring will know what to do in the interests of scientific bird-study.

I started my study of the individual sea-bird with the Manx shearwater (*Puffinus puffinus puffinus* (Brünn.)), the habits of which were at that time very little known. There are probably ten thousand pairs breeding on Skokholm. The shearwater nests in a hole in the ground, sometimes deep in a rabbit-hole, but it will also excavate a hole for itself in soft ground. A small colony nested in shallow burrows within a few yards of my back door. So it was not difficult for me to trace with a stick the winding of the burrow to the nesting recess at the end, and to cut out a turf immediately above the nest, and then to use that turf as a convenient inspection lid.

By degrees my wife and I were able to work out something of the Manx shearwater's life-history. The burrow would be inhabited so early in the year as February, the paired birds meeting each dark night as if they were determined to make sure of their nesting territory for another season, although the egg would not be laid until late April or May. Ringing has since shown us that the old breeders always arrive first.

Sexes are indistinguishable in the field, but in some cases we knew the female by finding her on a new-laid egg. In any event both birds were ringed. Only one egg is laid, and incubation is equally shared. Thus the male, for example, would spend two, three or four days on the egg without quitting the burrow. Then the female would take over. On dark nights, the bird at sea would return and converse with the sitting bird for an hour or two, but would not necessarily relieve it. Nor could we get any evidence that it fed its sitting mate. We came to the conclusion that the sitting bird stuck to the egg as long as hunger permitted, or as long as it could retain possession of the egg against its mate's determination to brood it. This at least appears to be the explanation of the irregular shifts or watches by one or other of the pair on the egg on dark nights.

On moonlit nights, however, this ardour to incubate was cooled by what we presume must be the bird's fear of being seen and killed by the many predatory gulls and hawks which frequent the island. So when a period of moonlit nights intervened, the bird at sea never visited the bird on the nest. Thus for five, six, seven, and more rarely up to ten, and once twelve, nights and days when the moon happened to be near or at the full, and the skies cloudfree, the sitting bird remained brooding but starving at the nest. We even weighed some of these starving birds and proved an average loss of a very small fraction of an ounce every twenty-four hours. Starving is really the wrong word, though at the time it seemed appropriate enough. Now we have found that a sea bird can easily endure long fasts, and no doubt this fact will help us to understand how the sea-bird rides out long storms at sea, when the weather conditions are such that feeding may be impossible and the bird's energies may have to be directed entirely to fighting the storm.

The incubation period of the shearwater we found to be a record for a British breeding bird—fifty to fifty-four days. One parent remained in the burrow by day to brood the downy chick for the first week of its existence; but afterwards the chick was only visited by night. When the moon was bright at night, the same thing happened as during incubation—the burrow was not visited at all. The young chick thus early had its first lesson in fasting. However, it was fat from the day of its birth, and showed no perceptible sign of going back during the occasional enforced fasts; in fact

* From a Friday evening discourse delivered at the Royal Institution on November 18.

it seemed simply to sleep and, so to speak, consolidate the position already gained. At any rate, this programme of cramming interspersed with an occasional fast results in the chick becoming enormously fat by the time it is sixty days old. To our surprise, we now found that the parents deserted the chick. They had spent sixty days gathering fish for it and many nights of feeding it with the result of that gathering, from a supply of semi-digested food stored in the parental crop. Now suddenly and completely they gave all this up. They went off to sea and certainly would not appear on the Island again until the following spring. We can surmise, if we like, that the physiological state immediately preceding the autumn moult has something to do with this, to us, rather unnatural desertion of the tender nestling. Yet if it seems unnatural, it is at least not improvident. At this age the chick was so fat that it could scarcely waddle to the sea. If it did so and plunged over the cliffs it would drop and go to pieces on the rocks below.

But after nearly a fortnight of fasting, the fledgling is fully feathered and has very little down visible. It takes off for the sea at night, blundering along on all fours, using wings and legs and beak to scramble over rough ground, for it cannot fly yet. When it reaches the cliffs, it is now light enough to flap down on a long plane and so avoid the rocks below.

Once in the sea the young bird is safe. We have taken shearwaters at this stage and put them in the sea by day. How thirsty they were—I wonder if thirst may not be for them an important factor in drawing them to the sea, the sound of which they must hear before they leave the nest. At any rate, their first action is to drink, then to wash; then suddenly they discover that they can dive. They half-open their wings so that the quills remain partly spread, like a half-opened fan, and with these strong paddles they swim under water with the agility of penguins. They come up for air, and dive again, and so gradually work off to sea, apparently making haste to leave behind the land, of which they have perhaps unpleasant memories of hunger and thirst.

Although we have ringed these young birds, for the time being we have lost them as individuals. But not for long. Recoveries at sea of some of these ringed birds prove that the shearwater has a winter haunt as far south as the Bay of Biscay.

We find that the old breeding birds return faithfully to their nesting burrows early in the spring, and ringing proves that the same individuals pair for another season, probably for life. The breeding bird has built up an association of memories—I scarcely like to call them visual memories in view of the fact that some of the most important events take place in the pitch blackness of the burrow—which lead it back to the same burrow. It must lose contact with its mate at times at sea in winter, possibly altogether. I do not know. But at least the nest is the focal point, the well-remembered place of meeting, and, allowing for frequent gaps caused by death, we have proved by means of ringing that the shearwater pairs for life.

You may ask, what about the young bird? Does it, too, in succeeding years return to the nesting burrows in one of which it was reared? So far we have not recovered a young bird in the immediate neighbourhood of its birthplace. But it is obvious that in order to keep up the numerical strength of the species a great many young birds must return to breed on the island. It is interesting to speculate as to whether they are guided to the island in the spring by the movements of the adults or by memories of fledging days. Possibly both these factors operate, and the young bird gradually builds a fresh association of memories during preliminary visits to the island. It discovers an empty crevice or hole one night and finds a mate, or more properly I should say a sweetheart, and plays at housekeeping. Next year it will return to this spot, search for or dig a more suitable hole, and start a home in earnest.

To return to more definite information. At present we have adult shearwaters under observation which bred with us for three and four and five years running, and there are two individuals which have bred seven years running. Allowing that the shearwater does not breed until nearly two years old, we thus have individuals five, six, seven and nine years old. So that in time we may well be able to work out the average duration of life of this species.

We have conducted some experiments with ringed sea-birds in an attempt to learn something more of their reputed homing power. An adult shearwater was taken from its egg on Skokholm and released at Start Point in Devon, which is about 200 miles from the island by the sea-route around Cornwall, or 125 miles overland as the crow flies. When released it flew low over the waves, making for sea. It did not attempt to rise up and strike overland in a bee-line for the island. Yet that bird was back on its egg at Skokholm within ten hours. So that if it continued by the sea-route it must have flown steadily at twenty-two miles per hour. Of course its speed by this sea-route must have been much greater, since a shearwater normally does not travel in a straight line, but has a curving, deviating flight, and probably it paused to drink if not to feed.

Two birds released at Frensham Ponds, Surrey,

performed a similar feat and were back at their nests the following night; but in this case before reaching the sea after release these birds had to cross forty miles of land. But land masses interposed between shearwaters and the sea do not seem to disturb the homing faculty. Shearwaters released inland at Birmingham, Evesham and Manchester, as well as at Limerick in Ireland, have safely homed to Skokholm, though not with the rapidity of the Start Point and Frensham releases. Other birds released in the Firth of Forth and as far north as the Faeroe Islands, and as far south as France and north Spain have also got back to their nests on Skokholm in varying times.

All these homing experiments were within, or (in the case of the inland releases) bounded by, the known sea-range of the species. We needed to go farther afield and see what would happen to birds released outside that range. The farthest distance by sea which we could easily arrange for without transport hardships for the birds (for we wished to be sure they were in good condition for a long flight), was Venice, approximately 3,700 miles from Skokholm via the Adriatic and the Straits of Messina and Gibraltar. Two shearwaters from separate nests were sent, by courtesy of Imperial Airways, to Venice, the distance by air being a little less than one thousand miles. So far as I know the Manx shearwater does not enter the Mediterranean, and therefore is not found in the Adriatic. Certainly ringing has so far proved that our Skokholm birds in their winter wanderings do not go beyond the Bay of Biscay. One of these two shearwaters is an individual of some interest to us, for it has returned to its burrow on Skokholm for five consecutive summers. It had already returned safely from Frensham. Now it returned from Venice in fourteen days. It is impossible to say whether it found its way out through the Straits of Gibraltar, or whether it made a bee-line straight over the Alps, or whether it crossed the backbone of Italy and then over the Pyrenees to the Bay of Biscay. The other shearwater may have returned from Venice in that summer; but we did not catch it until the next spring, when it was back at its usual nest.

These experiments have proved a remarkable homing ability, but we have still nothing but theories to explain it, and the physiological mechanism remains obscure.

We have made similar studies of individuals of other species of sea-birds; the storm-petrel, *Hydrobates pelagicus* (L.), for example, which breeds in numbers in the rock crevices and old farm-walls of Skokholm. In a similar study of individuals it has shown a life-history not unlike that of its cousin, the shearwater: nocturnal on land—a long incubation period of 38–40 days—and an average fledging period of 61 days. The chick is deserted in the end, and flies off to the sea on its own when sufficiently thinned down from its over-fat nestling stage. The storm-petrel is more nervous and difficult to observe than many sea-birds; but we have individuals on our books that have been breeding four years with us in the same crevice.

Our ringing study of the puffin, *Fratercula arctica grabæ* (Brehm), enabled us to discover several new facts: an incubation period of 40 days and a fledging period of 49 days. Also the surprising truth that this bird too is deserted by its parents, although other members of the auk family to which it belongs, the razorbill and the guillemot, feed and accompany their chicks at sea when these leave the rocks where they were hatched. The puffin follows the petrel family in deserting its single chick; but this desertion, as with the petrel family, is a wise provision. The young puffin is often reared in burrows some distance from the edge of the cliffs, and so has a long walk to get to that edge, and during that walk it would be exposed to the attacks of predatory gulls and hawks. The puffin chick is full-grown and very fat when it is deserted by its parents. It certainly needs a fast of a week or so to make it light enough to take off without fear of crashing on the rocks below the cliffs. So the young puffin solves two problems, the problem of its excessive weight, and the problem of the predatory gull, by starving for some days before selecting a dark night for its lonely and unseen but momentous stroll to the cliff edge, where it takes the plunge to that friendly element, the sea.

I have spoken of ringing large numbers, even thousands, of sea-birds, and it may be wondered how it is possible for one person to do this and keep account of so many individual birds from year to year. When I began this study of the individual sea-bird I had only my wife's help, and very valuable this was. But we should scarcely have been able to carry on this work as well as our normal duties had we not received encouragement from outside, an encouragement which we were most grateful to have. In the last few years other students have come along, until a voluntary organization has grown under the name of Skokholm Bird Observatory. It is now so organized as to permit us to endeavour to ring every breeding bird on Skokholm, from a rock-pipit to a gull, and to the gannets of Grassholm. We also catch many migratory birds which use the island as a temporary resting place. For example, we ringed in 1938 more than six thousand birds of sixty-one species. This is a figure comparable with figures achieved by subsidized observatories in foreign countries. In Germany and Italy and the United

States, ornithological work of this nature is recognized officially as having an educational and scientific value, and it is blessed with the practical support of the Government concerned. Here in Britain ornithology outside museums depends entirely on voluntary support. So that the running of an observatory on a remote island is not without its anxieties in more than one direction. Rings at three-farthings each add up to a considerable figure in one year, and there is a very large amount of clerical work in the recording and card-indexing of thousands of individual ringed birds. Nevertheless, this voluntary organization is being carried on for the present, and is about to issue its third modest annual report.

Finally, it may be suggested that catching and handling birds must disturb them unduly. On the contrary, by gentle handling many birds have become so used to us that they are almost tame, as tame, in fact, as wild animals are in nature reserves where they have learned that no harm will come to them from human beings. Indeed if the birds were not reasonably tame, it would be impossible to study them individually. This way of studying birds by ringing them is a good deal better than the old way of studying them by means of the gun and the collecting box. Ringing establishes a new kind of contact, a sort of friendly conspiracy with the living bird.

British Empire Cancer Campaign

THE fifteenth annual report of the British Empire Cancer Campaign was presented at a meeting held at the House of Lords at the end of November. The Duke of Gloucester, as president, announced at the meeting that a new cancer research centre of the Campaign was to be established at the University of Oxford and a grant was voted for the work to be carried on at this new centre. During the last year, £50,000 was expended by the British Empire Cancer Campaign on research mainly in Great Britain. Ten years ago the corresponding annual expenditure was only £20,000.

During the past year a considerable amount of work has been carried out on the biological effects of radiations. Mr. H. Burrows, Dr. W. V. Mayneord and Dr. J. E. Roberts have found that the exposure of inflamed tissue in the groins of rabbits to X-rays (600 r.) produced malignant tumours in eight out of nine rabbits. Dr. J. C. Mottram has examined the effect of combined treatment with the carcinogenic hydrocarbon, 3 : 4-benzpyrene, and gamma radiation. Doses of 160–1440 r. increase the carcinogenic action of the benzpyrene, while higher doses of radiation inhibit this action. It would therefore appear that for tumour production by radiation there is an optimum dosage. Dr. L. D. Parsons has shown that treatment of mice with X-rays or with a carcinogenic agent both result in the deposition of some iron compound giving a Prussian Blue reaction, in the lymphoid tissue. It seems possible that carcinogenic action may be associated with hæmolysis. Lymph glands of mice bearing sarcomas produced by a carcinogenic compound have grown like sarcomas when transplanted into other mice. These changes occur in glands quite irrespective of their proximity to the graft, and the microscopic appearances suggest that they are not metastatic.

Research carried out at the Middlesex Hospital has shown that if rats bearing the Jensen rat sarcoma are cured by treatment with X-rays, they are afterwards immune to that tumour. Partially successful attempts to transfer this immunity have been made by injecting the fluid from irradiated tumours. Injection of the fluid from tumours which have received a dose of X-rays which would eventually cause their disappearance gives some resistance to this tumour in other rats. Work from the J. H. Burn Laboratories at Newcastle-on-Tyne on two rat tumours has shown that the Jensen rat sarcoma is much more radio sensitive than the Walker carcinoma. The Walker carcinoma also is more resistant to heat treatment *in vivo*, although the two tumours show little difference when heated *in vitro*. Both types of tumour are killed *in vitro* by heating for one hour at 45° or 3 hours at 43·5°.

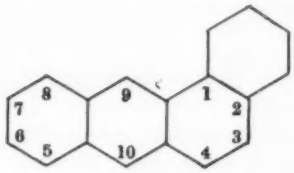
Experiment has frequently shown that radiation with split doses is more effective than a single exposure. Fresh experiments on mice with epitheliomata at the Mount Vernon Hospital have again confirmed this. Patients at that hospital are treated by the so-called 'stop and go' method in which the tumours are frequently examined and irradiated only when they are considered to be radio sensitive. The intervals between treatments are often as much as three or five weeks.

Investigations on the cancer viruses have not yet led to the isolation of these as chemical entities, but considerable progress has been made in the purification of the Rous chicken sarcoma virus.

It has been found that incubation with purified trypsin for short periods leads to increased activity of Rous tumour extracts, possibly owing to enzymic destruction of inhibiting substances present in the extracts. One of the difficulties in the problem of purification of this tumour-producing agent is the small amount present in tumours. The particles of the Rous virus are about 90 mμ in diameter, and recent experiments carried out by Prof. J. McIntosh show that the particles of the Shope rabbit papilloma virus are of a similar size.

Interesting results have been obtained by Sir Edward and Lady Mellanby on the dissemination of the Rous sarcoma virus in normal and malignant tissues. They have never been able to propagate a chemically induced tumour by cell-free filtrates. If, however, a fowl with a chemically induced tumour is injected with Rous virus, then cell-free filtrates of the chemically induced tumour may produce Rous sarcomata in other fowls. If cell innocula of this same tumour are grafted into other fowls, tumours resembling the original induced tumour are produced. These experiments show that chemically induced tumours cannot contain a virus with similar properties to the Rous virus. The Rous virus will pass not only to other tumours but also to normal organs, so that the blood and the organs such as liver, spleen, muscle and brain of fowls injected with the Rous sarcoma may all contain large amounts of the cancer-producing agent. The amount of virus in the organs is maximal between the seventh and twentieth days after inoculation with the tumour. If intravenous injections of Rous virus are given to fowls, the virus disappears from the blood and is taken up by the organs of the body, but generally no tumours are produced. The organs contain the virus, but do not develop tumours. If, however, a muscle is injured immediately after intravenous injection of the virus, tumours develop at the site of injury, but if the injury is made before injection, then no tumours are developed.

Research into the chemistry of carcinogenic compounds is a branch of cancer research in which the British contribution is pre-eminent. A large number of carcinogenic hydrocarbons have been discovered, some of which are much more active than coal tar and many of which are derivatives of 1 : 2-benzanthracene. All the theoretically possible monomethyl derivatives of 1 : 2-benzanthracene have now been synthesized, and of these compounds the 5-, 9- and 10-substituted compounds have definite carcinogenic action; 3-, 4- and 6-mono-methyl-1 : 2-benzanthracenes have slight activity. The carcinogenic agent of coal tar, 3 : 4-benzpyrene, can be considered as a derivative of 1 : 2-benzanthracene with an additional group in the 9 position; while methylcholanthrene is another derivative with substituents in the 10-, 5- and 6-positions. A new derivative, 9 : 10-dimethyl-1 : 2-benzanthracene, has been found to be the most active cancer-producing compound known, producing tumours in about one half the time required by methylcholanthrene.



1 : 2 BENZANTHRACENE.

Some relationship between chemical structure and carcinogenic action of 1 : 2-benzanthracene derivatives can therefore be shown. If two groups are present in positions in the benzanthracene nucleus (that is, particularly the 5-, 9- and 10-positions) which favour the development of carcinogenic action, then these groups reinforce each other in increasing cancer-producing activity. This summation of the effect of groups in producing cancer activity is analogous to the summation of different cancer-producing factors. One example of this is the combined action of a carcinogenic compound and X-radiation mentioned above. Treatment with carcinogenic agents often increases the incidence of cancer at some particular site to which the animal is normally susceptible. Thus mice have a natural tendency to cancer of the lung which is increased by treatment with carcinogenic substances. In an experiment reported from St. Bartholomew's Hospital, 1 : 2 : 5 : 6-dibenzanthracene was introduced into the stomachs of mice in an attempt to produce cancer of the alimentary tract. All these mice, which survived six months, developed lung cancer. Old rabbits are liable to uterine cancer, and in an experiment in which 1 : 2 : 5 : 6-dibenzanthracene was administered to rabbits by various routes, no tumours were produced at the site of application. A large number of uterine tumours, however, were found, which suggests that the carcinogenic compound possibly increased the incidence of this form of cancer. The tissues of the rabbits to which the substance was applied appeared to be resistant to tumour formation, for the same treatment in mice, rats or fowls would certainly have produced cancer in a certain proportion of animals. Invertebrate animals are not known to suffer from cancer; in the Leeds laboratory earthworms have been kept in earth containing 3 : 4-benzpyrene for twenty months without showing any histological changes.

Dr. A. Haddow has continued his investigations on the growth-inhibiting action of carcinogenic and related compounds. When animals with tumours are treated with such substances together with X-rays, a summation of effects is obtained. In many cases, animals treated with a carcinogenic agent alone showed active regression. There are many references in the report to experiments on the possible treatment of cancer by chemotherapy, and the fact that an effect is sometimes obtained by such treatment suggests that development of this method may occur in the future. E. B.

State Aid for Scientific Research in Great Britain

SINCE the Committee on New Industrial Development, appointed by the Economic Advisory Council, issued its report in September 1932, the structure and financing of scientific and industrial research has attracted the continuous attention of scientific workers. Many of those interested in the research association movement were concerned as to the future of those associations when the Million Pound Fund was exhausted, and an article from Mr. H. W. J. Stone, secretary of the Parliamentary Science Committee, which appeared in the *Nineteenth Century* in November 1933, urged the importance of more adequate endowment of research and suggested the allocation of revenue for this purpose from the new tariff revenue. Less specific proposals that the granting of tariffs to an industry should be made conditional upon adequate support of research have from time to time been advanced (cf. NATURE, 131, 67 ; 1933), while the national organization of research was discussed much more recently by Sir Daniel Hall in an article in the *Nineteenth Century* in which he proposed the formation of a Planning Council in place of the Economic Advisory Council, to co-ordinate the planning of research and the work of the Medical Research Council, the Department of Scientific and Industrial Research and the Agricultural Research Council.

Other considerations besides finance have focused attention upon the organization of research, particularly the growing importance of social research, the recognition of the disparity between research effort in the physical sciences and in the social and biological sciences, and the need for some reorientation of effort. Still more recently, national defence considerations have reinforced the cause for further co-ordination of effort. Prior to its merging in the British Association, the British Science Guild gave some attention to the financing and organization of research, and it may be expected that this same question will receive early attention at meetings of the newly formed Division of the Social and International Relations of Science. Closely associated with the British Science Guild in its consideration of this matter until 1936 was the Association of Scientific Workers. Since then, in collaboration with the Parliamentary Science Committee, the Association of Scientific Workers has continued its interest in the question, and a preliminary draft memorandum on the financing of research was prepared (see NATURE, 138, 51 ; 1936). The final draft of this memorandum was transmitted to the Lord President of the Council in April 1937 and has now been published in the *Scientific Worker*, the November-December number of which is devoted entirely to the finance of research, including with the memorandum, the report to the Lord President of Council of the Advisory Council, together with the reply of the Parliamentary Science Committee and the final report of the Advisory Council giving its reasons for not endorsing the proposals. A memorandum on private enterprise as a factor in industrial research is also included.

The main thesis of the argument is that scientific research should be provided with a regular and increasing income. The present system is criticized chiefly because of the rapidly fluctuating amount of money available for research and the lack of provision for the steady development of scientific research in industry. Stress is also laid upon the adverse effect of the present position upon the personnel and conditions of employment of the scientific staff. Accordingly, it is urged that in financing scientific research the first requirement is that it should provide security for completing work undertaken, and the second that it should make provision for steady and maintained expansion of research.

Pointing out that the ultimate sources of money needed for research are the Government and industry, the Parliamentary Science Committee discusses in its memorandum ways in which both might contribute. The idea that scientific research should be financed from Government sources alone is rejected, and also the method of raising funds by a statutory levy from the several industries concerned. Equally the alternative method of a voluntary levy is regarded as unsatisfactory, because it has "the double disadvantage of

penalizing those firms who contribute as against those who do not and affording an extremely irregular income for scientific research".

The memorandum argues, therefore, that if the principle be accepted that industry should contribute directly to scientific research, a way must be found of converting variable contributions into a fixed income; and the proposals outlined are intended to achieve this by the endowment of research. They are summarized in eleven recommendations, four of which are concerned with the needs, maintenance and development of the existing research associations, particularly with regard to continuity, and are strictly independent of the means taken to raise the funds for necessary research. The remaining seven recommendations outline the scheme for endowment of science.

The first four recommendations propose that the Government contribution to the research institutions and to research associations should take the form of block grants for a period of five to ten years in advance, and that the Department of Scientific and Industrial Research, with the Medical and Agricultural Research Councils, should endeavour to obtain a corresponding guarantee of industrial contributions for a corresponding period. It is also recommended that negotiations should be undertaken by the Department with industries for which research facilities are at present inadequate, with the view of providing a comprehensive system of Government-aided industrial research.

The second group of proposals recommends the establishment of a National Scientific Research Endowment Fund, to which the Exchequer would contribute an annual sum of £3,000,000 (or £2,000,000–£4,000,000) or 10 per cent of the value of Customs receipts. Part of this sum should be used to defray the Government contribution to scientific research, the accumulated reserve of the Fund being invested and the income used to defray part and ultimately all of the expenditure on scientific research. It is also recommended that the Department of Scientific and Industrial Research should endeavour to secure, from industry and agriculture, contributions to the Fund which, over a number of years, would provide an aggregate equivalent to that provided from Government funds. Control of the Fund and of the payments from it to scientific research would be vested in a Scientific Research Endowment Board, an autonomous authority including representatives of Government departments, industry, agriculture and scientific and medical associations, the universities and the public.

In observations on the scheme, the Committee stresses the need for a rationalization of the present organization and for an attempt to bring all scientific research—State, university and, so far as possible, industrial—into one comprehensive ordered and yet flexible scheme. It is pointed out that the scheme is intended to direct attention to four primary needs which must be met before science in Great Britain can be regarded as making its full contribution to the national welfare: a large income for science; a steady income, not dependent on general economic fluctuations; a greater degree of co-ordination of activities; and the completion and development of its connexion not only with part but also with the whole of industry, agriculture and health.

Obituary Notices

Prof. A. W. Porter, F.R.S.

THE death of Prof. A. W. Porter, which occurred at West Kirby, Cheshire, on January 11, has deprived physical science of the services of one who has played a notable part in the development of physics in Great Britain. His death was not wholly unexpected, for, as the result of a fall experienced during the bitter weather of the winter of 1937–38, a fall in which he suffered serious injuries, his health had declined.

Alfred William Porter was born on November 12, 1863. He took up the study of physics at a later age than is usual and, after a course of study at University College, Liverpool, he migrated to University College, London, whence he graduated in the University of London in 1890. He was a fellow of University College, London, and for many years assistant professor of physics in the College, finally being appointed to a University chair of physics in 1923, from which chair he retired in 1928, with the title of emeritus professor.

Porter's contributions to physical science were the products of an erudite and highly critical mind. It has been said of Maxwell that he had a vast knowledge of the history of his subject, and could always relate some incident about the most familiar fact which would give to it an added interest. Much the same may be said of Porter, who, moreover, had an innate capacity for the critical discussion and elucidation of delicate points dealing with the fundamentals of the different branches of physical science. He was specially happy in such subjects as osmotic pressure, capillarity, colloidal science, and heat, and many generations of students will look back with gratitude to the help they have obtained from verbal discussion with Porter.

His literary activity was great and varied. The treatise on magnetism and electricity known as Carey Foster and Porter's edition of Joubert-Atkinson was far more than a mere translation of Joubert's work, and reflects, in considerable measure, Porter's skill as a teacher. His articles on surface tension in the fourteenth edition of the "Encyclopædia Britannica" and on thermal expansion in the "Dictionary of Applied Physics", are excellent examples of Porter's massive learning and powers of clear exposition, and his capacity for throwing new light on an old problem is admirably shown in his presidential address to Section A (Mathematical and Physical Sciences) of the British Association at Glasgow in 1928, an address which dealt with the Volta effect and some problems in thermo-electricity.

One of Porter's earlier books, a treatise on elementary mechanics, is less widely known than its merits deserve. It was one of the first elementary books to inculcate sound teaching concerning the nature of mass, and the whole subject is developed by easy stages and by the use of the simplest mathematics to a point at which the reader is introduced to the solution of problems concerning the two-dimensional motion of a rigid body. Porter was also the author of two monographs on thermodynamics and on the method of dimensions, and completed, with a considerable measure of success, the difficult task of bringing out a new and revised edition of Preston's "Theory of Light".

Porter was always at his happiest when handling problems dealing with the manifestations of surface energy, and of late years had occupied himself with the calculation of the form of the capillary surface of revolution, giving special attention to the region in which the ordinary methods of approximation are of little use. In these calculations, he never lost sight of the needs of the experimenter, and his results are of great assistance to those concerned with the determination of capillary constants.

Porter's services to physics on the administrative side were most valuable. For many years he acted as secretary to the University of London Board of Studies in physics; he was one of the founder fellows, and the first honorary secretary, of the Institute of Physics. In this last-named capacity he played no small part in forming and in guiding the policy of the newly formed institution. He was president (1913–14) of the Röntgen Society, and president (1920–22) of the Faraday Society. At the time of his death, he was one of the editors of the *Philosophical Magazine*.

Porter was temperamental, and, like most temperamental men, was apt, on occasion, to take up hurriedly a completely indefensible position—and thoroughly to enjoy defending it. He was all the more lovable on that account, for his mind and outlook were always generous, and it is with real and deep sorrow that his many friends of all ages realize that they have looked their last upon the eyes kindly twinkling behind their gold-rimmed spectacles, and that they can no longer call upon that great store of ordered knowledge that was always so readily placed at their disposal. A. F.

Prof. T. W. Todd

THE death was announced from Cleveland, Ohio, on December 28, 1938, of Prof. Thomas Wingate Todd, anatomist and anthropologist, at the age of fifty-three years. He was born at Sheffield, England, in 1885, and entered the University of Manchester as a student of medicine, graduating in 1907. His attention was originally devoted to surgery; he became a fellow of the Royal College of Surgeons of England in 1911. His early love for anatomy reasserted itself, and he entered the anatomical department of his university as demonstrator and then as lecturer under Prof. Young and later under Sir Grafton Elliot Smith. His first research was on the relationship of cartilage and bone cells to bone formation. Incidental observations led him to infer that certain changes in the coats of arteries were due to pressure on sympathetic nerves.

In 1912, Todd was invited to the chair of anatomy in the Western Reserve University, Cleveland, Ohio. His colleague in physiology was another British subject, the late Prof. J. J. R. Macleod. He had occupied his chair for twenty-six years at the time of death, and had extended his department to many times its original dimensions. The researches carried out by him were of a threefold nature. When he wished to settle such simple matters as the order in which epiphyses unite with their shafts, the times at which the sutures of the skull close, the changes which the human face undergoes from childhood to adolescence, the changes undergone by the bones of the skeleton from maturity to old age, the manner and extent to which male bones differ from those of women, he discovered that such questions could not be answered because there was nowhere in the world a collection of human skeletons of which the age and sex were known. He set to work and slowly accumulated within his department skeletons of white Americans and of American Negroes, of known age and sex. At the time of his death this standard collection contained more than three thousand skeletons, besides skeletons of mature and immature animals—especially of those which most nearly approach man in structure. Fellow researchers joined him from many parts of the world; paper after paper dealing with age and sex changes as manifested in his collections of human skeleton appeared in the *American Journal of Physical Anthropology*, the *American Journal of Anatomy*, the *Journal of Anatomy* and the *Anatomical Record* during the past twenty years.

During the last twelve years of his life, Todd organized a survey of the growth changes in childhood. With the aid of the Brush Foundation, he obtained opportunities and means of keeping eight hundred children, born in Cleveland to well-off parents, under observation from infancy to full maturity. Four times yearly each child was examined medically and physically and records made—especially X-ray records—of the growth changes in their bones. His aim was to obtain a series of stages which would serve as a standard of the normal for medical men and especially for school medical officers. In

1937, appeared the first volume of his results, under the title of an "Atlas of Skeletal Maturation" (St. Louis, 1937). This first volume contains 75 plates giving X-ray photographs of the human hand, each plate representing a certain stage of normal growth. Subsequent volumes were to deal with the growth of other parts and regions of the human body.

Todd made the alimentary tracts of his students the subject of a systematic X-ray survey, his object being to determine what might be the normal dispatch of a bismuth meal in healthy young men, and the extent to which the normal may be departed from within the range of health. His observations were summed up in his Beaumont Lectures of 1930 and published in book form under the title "Behaviour Pattern of the Alimentary Tract".

Todd's object was to lay sure and wide foundations on which other workers might build. He lived and worked to the utmost limit of his bodily and mental strength. He sowed on an immense—an almost unprecedented—scale; it was when he harvested and especially when he came to thresh out and market his grain that his life's endeavour fell short of greatness.

ARTHUR KEITH.

Mr. S. H. Ray

MR. SIDNEY HERBERT RAY, whose death was recently announced, was born in London on May 28, 1858. In January 1882 he was appointed by the London School Board as assistant master in the Olga Street School, Bethnal Green, a position which he held until his retirement in May 1923. He was twice married, but had no children. He died on January 1, 1939. By unremitting labour, combined with a peculiar gift for languages, he raised himself to an honoured position in linguistic science. A noticeable characteristic of Ray was the absence of self-seeking; he worked under conditions which a less devoted man might well have found impossible. Nothing daunted his enthusiasm, and he became a recognized expert in a neglected field of linguistics.

This is not the place to detail his numerous papers on Papuan, Melanesian and Polynesian languages. On suitable occasions he exposed those who juggled with words in order to support vain theories of origins, for the construction of a language and its phonology were to him of prime importance. His studies of particular languages, however, afforded a basis for those wider surveys in which he gave to students the benefit of his erudition.

In 1892, Ray read a paper on the languages of British New Guinea at the Ninth International Congress of Orientalists, in which he showed definitely that there are languages in New Guinea that differ in vocabulary and grammar from the Melanesian and Polynesian spoken in western Oceania and also from the undoubtedly Melanesian of south-east New Guinea. These non-Melanesian languages he named Papuan as a convenient term for numerous distinct languages with archaic features; about the same time, W. Schmidt made the same deduction for German New Guinea. In 1894, Ray recorded traces of Papuan languages in various islands of Melanesia. In the same year he demonstrated that the Motu and allied languages of south-east New Guinea were not eastern Polynesian, as had been believed, but were Melanesian. He regarded the languages of the Masim area as originally Papuan upon which have been grafted words and idioms from Melanesian tongues. Their Papuan origin accounts for their diversity, and the Melanesian element, which is common throughout the area, accounts for their partial agreements.

When Ray visited Torres Straits and British New Guinea (Papua) as a member of the Cambridge Anthropological Expedition to Torres Straits in 1898, he for the first time was able to study various languages from the mouths of the natives, and he was untiring in his endeavour to make the most of his opportunities. His assiduity was such that he continually reduced his informants to exhaustion, while he himself remained quite fresh. In 1907 he published, as volume 3 of the Reports, a monumental work on the languages of New Guinea, which extended and confirmed his previous deductions. He proved that the western language of Torres Straits belonged to the same group as those of northern Australia, and that the eastern language was Papuan and allied to certain languages of the extreme west of Papua.

In 1926, Ray published a comparative study of the Melanesian languages, a further proof of his industry and erudition. In Melanesia there is a linguistic sub-stratum which differs from island to island. Upon this was grafted an immigrant Melanesian language which had spread at an early date from Indonesia and through its simpler grammar and facility of expression obscured the radical differences of the older languages. Later there were colonists from Indonesia who settled mainly on some of the smaller islands and introduced a pidgin-tongue. The words can only rarely be referred to any one original Indonesian language and they form only a small proportion of the vocabulary of any single language. The linguistic diversity in parts of Melanesia suggests that the Melanesian languages were originally variant stocks and that their apparent uniformity has been brought about by the influx of Indonesian words and idioms. This was the first of a projected series of studies, but the expense of their publication prevented the appearance of further volumes. In more favourable circumstances, Ray could have enriched linguistic science to a much greater extent; we can only marvel that, handicapped as he was, he accomplished so much work that will have a lasting value.

A. C. HADDON.

Prof. E. H. Hall

PROF. EDWIN HERBERT HALL, emeritus professor of physics in Harvard University, whose death occurred on November 20, devoted most of his life to the study and investigation of electric conduction. He will doubtless be most remembered by the Hall effect which he discovered in 1878. This effect is the production of an electromotive force when an electric

current flows across the lines of force of a magnetic field. This electromotive force is perpendicular both to the magnetic field and to the electric current or, speaking more generally, it is proportional to the vector product of the last two quantities. Other aspects of electrical conduction to which Hall made contributions include the Thomson effect in soft iron, thermo-electric heterogeneity in different metals, the theory of thermo-electric action and of thermal conduction in metals and the relations of the four transverse effects of the magnetic field (the Hall effect was the first of these to be discovered). His keen interest in this field was maintained to the end of his life. In fact, a book entitled "A Dual Theory of Conduction in Metals", in which he summarizes his considered views on the subject, has recently appeared.

Hall was born at Gorham, Maine, on November 7, 1855, and educated at Bowdoin College and Johns Hopkins University. Practically the whole of his working life was spent in the service of Harvard University, in which he joined the Physics Department as an instructor in 1881, became professor in 1895 and emeritus professor in 1921. He attended the Solvay Conference at Brussels on the Conductivity of Metals and Related Problems in 1924 and the Volta Memorial Congress at Como in 1927. He was a member of the National Academy of Sciences, American Association (vice-president in 1904), American Physical Society (member of Council 1903–6), American Academy of Sciences, and corresponding member of the British Association.

Hall's contributions to physics were not confined to the various aspects of electrical conduction. Among the other subjects he wrote of we find the changes in temperature of the walls of steam engine cylinders, the thermal conductivity of nickel and iron, the deflection of falling bodies and the air resistance to falling inch-spheres. Some of this suggests an interest in engineering as well as in pure physics. He was also the author of several text-books of physics of varying scope.

Hall was a kindly man and a pleasant companion. He was interested in a great variety of matters about which he could speak in an attractive and sometimes humorous way. He kept his interests alive until the end, and his loss will be felt by a wide circle.

O. W. R.

WE regret to announce the following deaths:

Dr. Calvin B. Bridges, known for his work on genetics at Columbia University and the California Institute of Technology, on December 27, aged forty-nine years.

Prof. H. H. Woollard, F.R.S., professor of anatomy in University College, London, on January 18, aged forty-nine years.

News and Views

Scientific and Other Services in War Time

FROM time to time in the columns of NATURE, reference has been made to the need for full consideration of the part that men of science can take should Great Britain be unhappily involved in a major war. The Association of Scientific Workers has recently had the subject under consideration (see NATURE, Jan. 21, p. 110) and has put forward proposals the fundamental principles of which will, we believe, meet with general approval. A sign that the Government was giving attention to this aspect of national defence was anxiously awaited. The appointment of an advisory council by the Minister of Labour to advise him on the utilization in war time in Government departments or elsewhere of persons with scientific, technical, professional and higher administrative qualifications would appear to be the answer. The representation accorded on the council to scientific interests will not satisfy everyone, but it must be admitted that it is substantial. Sir Walter Moberly has been appointed chairman of the council, and the following have accepted appointment as members: Sir Charles Bressey, Dr. E. J. Butler, Sir Eustace H. Tennyson d'Eyncourt, Mr. S. B. Donkin, Dr. H. L. Eason, Mr. A. H. R. Fedden, Dr. A. P. M. Fleming, Dr. G. S. Gordon, Dr. H. J. Gough, Sir Hector Hetherington, Prof. A. V. Hill, Viscount Leverhulme, Miss Hilda Martindale, Sir Edward Mellanby, Mr. J. S. Nicholson, Mr. Charles J. G. Palmour, Mr. H. Parker, Sir Robert Pickard, Dr. D. R. Pye, Mr. David E. Roberts, Mr. Basil Sanderson, Mr. T. E. Scott, Sir Frank Smith, Rear-Admiral H. G. Thursfield, Mr. R. S. Wood. The secretary to the Council is Miss B. M. Power, of the National Service Department of the Ministry of Labour, Montagu House, Whitehall, S.W.1.

Dr. Lev T. Berg

ICHTHYOLOGISTS throughout the world will be interested to learn that Dr. Lev Semenovich Berg, of Leningrad, has recently completed forty years work upon the fishes of his native country. One of his earliest papers, entitled "Ueber Theilung und Bildung des Parablastes bei *Esox lucius*", was published early in 1899, and from that time onwards a veritable stream of valuable contributions, mainly of a taxonomic nature, has flowed from his pen, and more than one hundred papers bearing his name have appeared in scientific journals throughout the world. Always a patient and careful worker, Dr. Berg has come to be regarded as the foremost authority upon the freshwater fishes of the U.S.S.R., and is a recognized authority upon problems concerning the geographical distribution of fishes. His imposing

work on the freshwater fishes of the U.S.S.R. and neighbouring countries, a third edition of which appeared in 1932–33, will long remain a standard work, invaluable to all students of Palæarctic fishes. Dr. Berg, who was born in 1876, is still actively engaged in his work, and his many friends and co-workers will wish him many more years of fruitful labour in ichthyology.

Mr. S. Hazzledine Warren

THERE is a special propriety in the award by the Geological Society of the Prestwich Medal to Mr. S. Hazzledine Warren. The ground of the award, as officially stated, is "in recognition of his researches on the geology and archæology of East Anglia, particularly in the Lea Valley"; but without detracting in any degree from the value and importance of his original researches and discoveries in this area, it is placed to his credit by archæologists that his severely critical attitude of mind on every point of evidence bearing on the antiquity, character, and condition of flint implements, and the natural or artificial origin of their fractures, has conduced to sanity in that study of the earliest evidence of man's handiwork, with which the name of Sir Joseph Prestwich has been associated from the earliest days when the discovery of 'eoliths' was first proclaimed. Throughout the whole of his long and distinguished career as a prehistoric archæologist, Mr. Warren has devoted himself indefatigably to the close scientific examination of such questions as patination, modes of fracture under varying conditions, and other matters depending upon the physical properties of flint, with the view of determining their evidential value as clues in the technology of antiquity; and if he has not always been able to go all the way with his fellow workers, it has been recognized that his conservatism has always advanced knowledge in a real sense and not retarded it. Of Mr. Warren's investigations in the field, posterity will perhaps be most indebted to him for his discovery of the Graig Lwyd factory site, significant for the light it throws on prehistoric economics, and his exploration of the Clactonian industry, which has had so profound an effect on all subsequent study of palæolithic cultures.

Pre-Crag Implements

A COMMUNICATION has been issued by Mr. J. Reid Moir recapitulating his arguments rebutting the criticisms of his claim for the human origin of the pre-Crag 'implements' discovered in, or derivative from, Pliocene deposits in East Anglia. It has been argued from their physical condition and the high angle of flaking that not only were these flaked flints produced by natural forces, but also that in actual fact they are such as could not have been produced, or if produced, used for their supposed purpose, by man. This, it is claimed, has been shown by experiment. To this Mr. Reid Moir replies, pointing out that the flaking of certain, and especially the older classes of pre-Crag implement could not have been produced by the forces responsible for the striations they exhibit, as these score a post-flaking patination; while the argument from the steepness of the angle of flaking—apparent in some instances only—and the inability of the modern critic to reproduce typical specimens applies equally to certain types of palæolithic implement, of which the authenticity is unquestionable. It has, however, been found possible to imitate high angle flaking experimentally, and the product is also a practicable tool for working wood and bone. Mr. Reid Moir classifies pre-Crag implements into five groups, which differ in age and in character of flaking. "Is it to be supposed," he pertinently asks, "that nature varied her methods of flaking flints five times in the Pliocene epoch?" Finally, as the result of many years' study devoted to the examination of later deposits, he asserts that never has he discovered a flint fashioned *in situ* which bears any resemblance to a pre-Crag implement, as might be expected were such flaking attributable to natural forces. At the same time it is to be remembered, he points out, that rostro-carinates have now been found in many parts of the world from Palestine to Java, where glacial conditions and solifluxion could not have operated to produce them.

Social Relations of Science

CORRESPONDENCE has passed between the British Association and the Parliamentary Science Committee concerning the possibility of a working liaison between the Association's new division for the Social and International Relations of Science and the Parliamentary Science Committee. At a recent meeting of the latter body it was decided to invite Sir Richard Gregory, in his capacity as chairman of committee of the new division, to accept co-option to the Executive Committee of the Parliamentary Science Committee, and this invitation has now been accepted by Sir Richard. Normally the Parliamentary Science Committee confines co-option to its executive to members of one of the Houses of Parliament. It was felt, however, that in this instance it was particularly desirable to make an exception in favour of the chairman of this newly formed division of the British Association. It was a fitting compliment on another ground, for, as the erstwhile chairman of the British Science Guild (now merged in the British Association), Sir Richard was intimately associated with the formation of the Parliamentary Science Committee. Indeed, had it not been for other preoccupations at the time, he would have been a member of the Committee from its inception.

Survey of Nyasaland Food Resources

A COMPREHENSIVE nutritional survey, under the leadership of Dr. B. S. Platt, the first of its kind to be undertaken in the British Colonial Empire, is now being carried out in Nyasaland with the object of studying the actual and potential food resources of three contrasting areas. This survey is the outcome of a recommendation made by the Committee of the Economic Advisory Council on Nutrition in the Colonial Empire. Dr. B. S. Platt has been appointed to the staff of the Medical Research Council for five years to organize and co-ordinate, with the assistance

of a small central staff, nutritional surveys throughout the Colonial Empire. The Nyasaland party, which is being financed jointly by the Medical Research Council and the Colonial Development Fund, actually arrived in Nyasaland some months ago. An anthropologist under the auspices of the International Institute of African Languages and Cultures is working with the party. The party is now being joined by Dr. C. K. Ricardo and by Dr. E. Trewavas of the British Museum (Natural History), who will undertake a survey of the fishery resources of Lake Nyasa; and also by Dr. G. A. C. Herklots, reader in biology to the University of Hong-Kong, who has been seconded for eight months to assist with the economic work. It is hoped that the surveys will produce valuable results, on one hand by increasing existing knowledge of the relation between nutrition and ill-health, and on the other hand by suggesting means whereby improvements in nutrition may be effected. It is also interesting to note that the present investigation in Nyasaland is the sort of scheme which Lord Hailey had in mind when advocating, in his recently published African Survey, that scientific research should form an essential basis of policy in Africa.

New Broadcasting System

ACCORDING to a recent report by the New York Correspondent of *The Times*, a new type of wireless transmission and reception will be used in an experimental station now being erected at Columbia University by Major E. H. Armstrong, professor of electrical engineering in the University, and inventor of the now well-known supersonic-heterodyne receiver. The station will use the frequency-modulation system of transmission, as distinct from the amplitude-modulation system at present used by all broadcasting stations. In the former method, the frequency of the emitted carrier wave is varied by the speech and music modulation; whereas in the methods so far employed, the frequency of the carrier wave remains constant and its amplitude is varied by the applied audio-frequencies. The principles of frequency-modulation have been known since the earliest days of radio-telephony, but it has remained for Prof. Armstrong to demonstrate how these may be brought into practical use with modern valves and circuit arrangements. Among the advantages claimed for the new system are that it effects a considerable reduction of interference in radio reception, and that a much larger number of broadcasting channels will become available in any given wave-length band. Against these, however, is the serious disadvantage that special receivers are necessary for frequency-modulated transmissions, and this factor is likely to involve serious delay in the introduction of the new system into modern broadcasting technique. The first transmitting station on the new system will be at Alpine, New Jersey, opposite New York City, and it has a licence to broadcast on a frequency of 40 megacycles per second (wave-length 7.5 metres). It is also understood that suitable receivers are already being manufactured, so that the result of this practical experiment will be awaited with interest.

North Rona: A North Atlantic Island

AT the Friday evening discourse at the Royal Institution on January 20, Dr. F. Fraser Darling described the island of North Rona. It is Britain's loneliest island; it lies forty-five miles north-west of Cape Wrath and north-east of the Butt of Lewis and is less than half a square mile in area. The island consists of Hebridean gneiss, but being free of peat and covered with a thin layer of soil, it differs radically from Lewis in its vegetative covering, which is of grass, quite free from heather. St. Ronan is reputed to be the first human inhabitant of Rona in the eighth century A.D. He built a cell almost underground, and much of the original building is still present. A chapel was built somewhat later contiguous with the cell and at its western end. Dr. and Mrs. Fraser Darling have excavated the accumulated stone and earth from the chapel and cell, disclosing the altar supports of masonry in the chapel, the rammed clay floor, the doorway into the cell, the original stone paving of the earlier building and the altar of masonry in the cell. Many quern stones and two fragments of stone vessels have been found. The wild life of Rona is of exceptional interest. There is an immense summer population of guillemots, razorbills, puffins, fulmar petrels, kittiwakes and great black-backed gulls. The storm petrel is also numerous, and Rona is one of the three British stations where Leach's fork-tailed petrel breeds. Rona is the headquarters of the Atlantic grey seal in Scottish waters, and a study of the social behaviour of this animal in the months it is ashore for breeding was the main purpose of Dr. Fraser Darling's expedition. Although this seal cannot dispense with the land for reproduction, this annual association with the land is a time of great danger. The social system is finely adapted to reducing the danger, and so are the animal's metabolic processes. The maiden cows and immature stock, for example, do not come ashore on the main mass of the island at the breeding season, but remain on skerries constantly ringed with surf. The calves feed from their mothers intensively for three weeks and are then weaned and left to find the sea for themselves. As the gestation period is 11½ months, mating takes place while the mothers are ashore with their calves.

Royal Meteorological Society

AT the annual general meeting of the Royal Meteorological Society held on January 18, Dr. B. A. Keen, the president, referred to the Council's activities in pressing for the installation of meteorological institutes in Great Britain, in order that urgently needed facilities, such as were available in many other countries, might be provided for research in meteorology in this country. The matter was also raised later in the evening, on the occasion of the award of the Buchan Prize to Dr. E. W. Hewson. Dr. Hewson, who is a Canadian and has recently been appointed to the Canadian Meteorological Service, was not able to be present to receive the prize, but in a letter which was read to the meeting he expressed his sense of indebtedness to the Beit Trustees and to the Royal Society of Canada for

the grants which had enabled him to carry out research in meteorology at the Imperial College of Science and Technology in London for three years; and he stressed the great benefit which could be conferred on science by the endowment of scholarships in meteorology which would permit post-graduate students to study meteorology in Great Britain. Dr. Keen's presidential address dealt with the subject of "What happens to the Rain?" An annual rainfall of 30 in. means that 3,000 tons of water fall on an acre of land. In the course of the year this all disappears, by run-off, evaporation, transpiration through vegetation, and by downward percolation. The relative importance of these factors in British and overseas conditions was discussed. It is only in recent years that the true picture of the movement of water in the soil has been built up. In consequence, some of the traditional practices need revision, while others now have a different explanation. The new work has also clarified some of the concepts used in hydrology.

Opening of Griffith Institute of Archæology, Oxford

THE Griffith Institute of Archæology, an extension of the Ashmolean Museum of the University of Oxford made possible by the generous benefaction of the late Prof. F. Ll. and Mrs. Griffith, was declared open on January 21 by Sir Frederic Kenyon in the presence of the Vice-Chancellor, Mr. G. S. Gordon, president of Magdalen College, and a large assembly of distinguished guests. Sir Frederic, speaking as an old friend of Prof. and Mrs. Griffith, said that never had he known a man more single-minded and more tolerant of the work of others than Prof. Griffith. The Griffith Institute would fill one of the great gaps in the equipment of the archæologist. The Vice-Chancellor and Mr. E. T. Leeds, keeper of the Ashmolean, also paid generous tribute to the memory and work of Mr. and Mrs. Griffith. The building in which the Institute is housed is of four floors, erected to the design of Mr. E. Stanley Hall. Three floors are allotted to Egyptology and Assyriology, while the ground-floor is given up to other activities of the Museum. The greater part of the Griffith library is housed in the Institute, and accommodation is provided for the professor of Egyptology and the reader in Assyriology. Space is available for the compilation of the topographical bibliography of Egyptian hieroglyphic texts and other research work, while a large store-room will provide for the Egypt Exploration Society's collection of papyri, which has been transferred from Queen's College, and the collections of ostraka and other material used for purposes of teaching. The University's collection of cuneiform tablets will be arranged in the rooms devoted to Assyriology.

Proposed Museum of Romano-British Archæology

LORD EUSTACE PERCY, Rector of the Newcastle Division of the University of Durham, has issued an appeal for funds for the erection of a Museum of Romano-British Archæology, devoted to the area of the Roman Wall at Newcastle-on-Tyne, in connexion with the University of Durham. The proposal arises out of a recommendation of the Standing Commission on Museums and Galleries made two years ago, which had in view the need both of facilities for study of the area of the Wall and also of the requirements of the magnificent collections of Romano-British antiquities belonging to the Society of Antiquaries of Newcastle, the main source of information concerning the Roman frontier in Britain and settlements adjacent, which have been brought together in the course of the last hundred years, and are now somewhat inadequately housed in the medieval Black Gate of the Castle. The Society has generously expressed its willingness to place its collections at the disposal of the University for this purpose, subject to certain conditions. Although the erection of such a museum had been contemplated in the projected building scheme of the University, it had been set aside for the moment in view of more urgent needs; but it has now been brought within the range of practicable proposals by the offer of a grant of £5,000 from the University Grants Committee, provided the further sum required to make up the total estimated expenditure of £20,000 is raised within a period of two years. The Museum will not be confined to Romano-British antiquities but will include all relics obtained from the area of the Wall, both prehistoric and of post-Roman date down to the Norman conquest. Subscriptions are being received by Lord Eustace Percy at King's College, Newcastle-on-Tyne, 2.

Testing Electric Meters and Appliances

THE opening of large extensions by the Lancashire Electric Power Co. on January 16 of its department for testing electric meters and electric appliances shows how rapidly this branch of the firm's work is developing. That part of the firm's revenue which depends upon meter registrations now exceeds a million pounds per annum, while the number of meters issued has almost quadrupled during the last nine years. A great deal of the extra work done is in connexion with household appliances, offered by the firm on hire and hire-purchase terms. These are installed and maintained by the testing department. The number of domestic appliances connected, such as cookers, water heaters, fires, kettles, etc. increased in number from 400 in 1930 to 10,700 in 1934 and to 38,000 last year. In the last two years, 2,000 thermostatically controlled cookers have been issued to customers. Nearly all the domestic consumers pay on a two-part tariff with a power charge of 0·5–1*d*. per unit. All meters are tested when removed from service, after which they are reconditioned and certified. A small cleaning room is provided for exceptionally dirty meters, the equipment of which includes a powerful blower and an extractor fan. At the opening ceremony, it was stated that an electricity meter is not only one of the cheapest but also one of the most accurate things the firm has on the market. Since 1936, all cookers offered by the firm have had automatically controlled ovens. Their thermostats are checked for consistency and the enamel is tested for durability. Tests include temperature measurements every

minute at five different points in the oven; if satisfactory, these tests are repeated with food in the oven. The L.E.P. Co.'s experience is that the most critical practical test of an oven is the baking of plate pies, and the next most critical the baking of bread.

Thermionic Valves as Measuring Instruments

THE thermionic valve has long been recognized as a useful tool in many branches of science and engineering; but few, with the exception of experimenters, have realized that it can be usefully applied for measurement purposes. Until quite recently, engineers have regarded the valve as being rather an unknown factor and so have been reluctant to rely on it when precision measurements are required. In a paper presented to the Institution of Electrical Engineers on January 6, by Dr. E. G. James, G. R. Polgreen and G. W. Warren, the principles are outlined of various kinds of valves for the measurement of alternating voltages (including 'slide-back', peak, grid-leak and anode-bend voltmeters) and of voltmeters and electrometers for direct voltages. Methods of measuring very small values of current and power are described. Although the uniformity existing between the characteristics of valves of the same type is not quite perfect, the modern valve gives a very stable performance during its life, more particularly under the operating conditions imposed in measuring devices. Of all valve-measuring devices, the valve voltmeter probably is the most widely used instrument, especially for high-frequency measurements. It is sensitive and it can be designed to absorb negligible power from the source. In normal instrument practice, current is measured either by its magnetic or by its heating effect, and voltage is measured by measuring the current through a known resistance. In the case of instruments employing valves, the converse procedure is adopted. Voltage is measured by its controlling action on the electron current in the valve, while current may be determined by measuring the voltage produced across a known resistance. A simple and inexpensive valve voltmeter can be made to operate from pocket lamp batteries. It makes a useful self-contained instrument with the general advantage of very high impedance and wide frequency range. The paper is a communication from the Research and Engineering staffs of the General Electric Co., Ltd., the M.O. Valve Co., Ltd., at Wembley and the works of the Salford Instrument Co.

Progress of Medical Psychology

IN an address at a public luncheon arranged by the National Institute of Industrial Psychology on January 18, Dr. J. R. Rees, medical director of the Tavistock Clinic, said that this century has seen very great progress in both the science and the art of psychological medicine. Moreover, in the treatment of neurosis and nervous breakdown and in medicine as a whole, the introduction of the principles of medical psychology in the last few years has brought about a greater change than anything else in medicine. In the basic understanding of the processes of mental disease, much is owed of course to Freud and his followers, but the work of Jung, McDougall, Adler, Rivers and Hadfield—to mention only a few—has been of an outstanding quality. The medical student can now be taught to understand the human beings with whom he has to deal without the use of any technical jargon and without any exclusive reference to a particular school of thought in psychology. In the actual treatment of the neuroses we are making steady advance. There is evidence from the careful follow-up work which has been done, first of all at the Tavistock Clinic and then at the Cassel Hospital at Penshurst, that approximately 50 per cent of the patients treated, irrespective of the particular method, seem to be permanently relieved and socially adjusted. That is a very satisfactory figure in comparison with the figures for other diseases. More important perhaps than the provision of treatment for the definite neuroses is the fact that through recent research we are coming to realize that many of the illnesses which have always been supposed to be mainly physical, have in fact a very large emotional factor in their causation. Psychological medicine is now coming into its own place in the system of medicine and is showing itself to have the closest possible relation to the problems of general medicine. The General Medical Council has now insisted that medical psychology should become part of the regular training of every medical student.

Flora's League

BOTANISTS, nature-lovers and those who are concerned for the conservation of the native British flora will be interested to know that it has been decided to continue the activities of Flora's League, the national society for the preservation of wild flowers, trees and ferns, as a memorial to its founder, the late Sir Maurice Abbot-Anderson. Sir Maurice, a distinguished physician, founded the society in 1925 and was its president up to his death, when it had a following of more than twenty thousand members and a wide influence through the public and school lectures it organized as propaganda for the preservation of the British flora from vandalism and unscientific collecting. Lady Abbot-Anderson has undertaken to carry on her husband's work as president of the League, which is closely associated with the Council for the Preservation of Rural England, the office of which it shares, and an appeal is being made for a fund to continue this work. In a statement on its policy, the League clearly refutes any suggestion of mere sentimentality or crankiness in its methods, for it points out: "There are inevitable economic influences at work which mitigate against the preservation of our wild flora, and with which we cannot quarrel. Building, road-making, drainage, quarrying and the like, must, in the ordinary course of things, proceed. Methods of transport also are more easily available, and bring enormous enjoyment, as well as increased health, to the population". A by-law against the uprooting of any wild plants from roadsides and places to which the public has access, without authoritative

permission or a special permit for scientific purposes, is one of the chief aims of the League, and this has already been adopted by fifty-two counties and sub-counties in England and Wales. From 1925, the whole of the expenses were met by the founder.

Mathematical Films

IN connexion with the note in NATURE of December 31, p. 1151, Mr. Stefan Bergmann writes to point out how films might be used to illustrate the theory of functions of two complex variables. Each complex variable may be represented as a point in a plane, requiring two dimensions, so two such variables require four dimensions. We may obtain these by taking three dimensions in space and one in time, in fact by making a film showing a solid body the dimensions of which vary with the time. Full details were given by Mr. Bergmann some years ago (*J. deutsch. Mathematiker Verein.*, **42**, 238; 1932–33), but so far as we are aware no such films appear in current lists of those available for sale or hire.

Nutrition and Local Government

THE Children's Minimum Council, 72 Horseferry Road, London, S.W.1, has issued a pamphlet entitled "Nutrition and Local Government—What Your Local Authority Can Do" (by Marjorie E. Green. Price 3*d*.). Although changes in legislation are still needed to ensure that no child shall suffer from malnutrition through the poverty of its parents, there are two Acts of Parliament, the Public Health Act of 1936 and the Education Act of 1921, which enable local authorities to provide supplementary nourishment, and this pamphlet sets out clearly what each local authority can do in its own area to solve this problem of child malnutrition.

Rheumatism Research in Naval Training Centres

THE Empire Rheumatism Council, in co-operation with the Admiralty, has set up a research foundation to investigate rheumatic disease in the training establishments of the Royal Navy. The research advisory committee has appointed a sub-committee consisting of Lord Horder, Sir William Willcox, Prof. George Hadfield, Dr. Mervyn Gordon and Dr. W. S. C. Copeman to supervise the work. Dr. C. A. Green, of the Bacteriological Department of the University of Edinburgh, is to take direct charge of the Foundation, and the Sir Halley Stewart Trust has appointed him to a research fellowship for three years for this task.

National Nutrition Conference

THE British Medical Association has decided to call a national conference on nutrition in its wider aspects—that is, in relation to national, including agricultural, policy—which will last three days, the dates provisionally selected being April 27–29. In addition to medical men, the conference will be representative of agricultural producers, home and over-seas, as well as of industry and education. The conference will take as its starting-point the recognized food needs of the individual, if health is to be maintained. Questions to be considered include: How far are these needs satisfied in Great Britain at the present time? What increases are required in the production of particular foodstuffs, either at home or in the Empire, to fill the gap? How can the necessary increases in consumption be best secured—through a system of family allowances; education, including propaganda; or otherwise?

Micro-Methods for Medical Practitioners and Biologists

IN conjunction with the Institute of Scientific Microscopy and Applied Optics of the University of Jena, Messrs. Carl Zeiss, Jena, are organizing a course of microscopy, microphotography, micro-cinematography, micromanipulation, luminescence microscopy, also absolute colorimetry, interferometry and spectral analysis, with particular reference to their significance in medicine and biology, to be held in Jena during March 27–April 1. During the lectures provided in the programme there will be talks by eminent authorities on optical methods. Of particular note is the fact that members will be offered the opportunity of widening their experience in the use of the apparatus and above all of trying out in practice the methods referred to during the lectures. Demonstrators and specialists will be available to answer all questions arising during the practical work in the laboratory. Further particulars and detailed programme can be obtained, in England, from Carl Zeiss (London), Ltd., Mortimer House, Mortimer Street, W.1.

New Comet and Super-nova

A TELEGRAM from Copenhagen reports that Peltier, at Delphos, Ohio, discovered a comet on Jan. 20.000 U.T., its approximate position being R.A. $21^h\ 20{\cdot}0^m$, Dec. $+28°\ 0'$, and its magnitude 8. A later telegram states that Beljawsky saw the comet several hours earlier and found that its daily motion was $+5^m\ 48^s$ in R.A. and $-0°\ 13'$ in declination. He gave the magnitude as 8 and estimated the tail to be about 1°. Other observations must have been available to Karstedt, who has computed the orbit and ephemeris given below; as the observations are very rough, the orbit cannot be regarded as more than provisional.

T 1938 Dec. 30·0 U.T.
ϖ 126°
Ω 305 } 1939·0
i 37
q 0·770

Ephemeris

	R.A.	N. Dec.
Jan. 21·0	$21^h\ 28^m$	27° 30′
25·0	22 29	26 36
29·0	0 39	18 42

Zwicky reports a super-nova, mag. 17 on January 14, 12·5 on January 20. It is 0·6′ north-west of the nucleus of N.G.C. 4636.

The Night Sky in February

THE moon is full on February 4 at $7{\cdot}9^h$ U.T. and new on February 19 at $8{\cdot}5^h$. Lunar conjunctions with the planets occur as follows: with Mars on February 12 at 13^h; with Venus on February 15 at 3^h; with

Jupiter on February 20 at 12h and with Saturn on February 23 at 6h. Jupiter, which has been a conspicuous object in the evening skies for some months, is now approaching conjunction with the sun, and in the middle of the month sets at about 18½h. Mercury and Jupiter are close to each other on February 26. Saturn is an evening star in Pisces; in mid-February the planet sets at about 21¼h. Venus is the bright morning star rising before 5h; its stellar magnitude is from −4·0 to −3·9. Mars rises some two hours before Venus, and is 5° north of Antares on February 12. In mid-February, the constellation of Orion, which focuses attention on the most spectacular region of the whole sky, comes to the southern meridian at about 20h. North preceding the Pleiades is the variable star, Algol, the light changes of which may be observed about 1½ hours before and after the following times of primary minima: February 9d 0·1h, 11d 21·0h and 14d 17·8h.

Announcements

PROF. G. INGLE FINCH, professor of applied physical chemistry in the Imperial College of Science and Technology, was presented at the Belgium Embassy on January 23 with the order of Commander of the Order of King Leopold II, which has been conferred on him by King Leopold III for services rendered to science in Belgium during his term of office as Fondation Francqui professor in the University of Brussels during 1937–1938.

PROF. VICTOR F. HESS, formerly director of the Physical Institute of the University of Graz, has been appointed professor of physics in Fordham University, New York, as from November last. His address is: Department of Physics, Fordham University, New York City.

MR. A. S. E. ACKERMANN has been elected an honorary fellow of the Society of Engineers (Inc.) upon relinquishing the secretaryship of the Society, which he has held for thirty-one years.

IT is announced that a sale by auction will take place at Stevens Auction Rooms on February 10, at 12.30, of the important collection of scientific instruments, the property of the late Edward Milles Nelson. They include microscopes by Leitz, Powell & Lealand, Swift, and other well-known makes, objectives, eyepieces, and other accessories, chemical balances and weights, a spectroscope, a telescope, drawing instruments; books, etc. Catalogues can be obtained from the Auctioneer, 38 King Street, Covent Garden, W.C.2.

AT the annual general meeting of the Royal Meteorological Society held on January 18, the following officers were elected: *President*, Dr. B. A. Keen; *Treasurer*, W. M. Witchell; *Secretaries*, H. W. L. Absalom, W. Dunbar, and E. L. Hawke; *Foreign Secretary*, J. F. Shipley; *Editor*, Sir Gilbert Walker; *New Members of Council*, Lieut.-Commander T. R. Beatty, L. C. W. Bonacina, and G. Manley.

AT a meeting of the Chemical Society on January 23, it was announced that Dr. H. J. T. Ellingham is resigning from the office of honorary secretary. The Council of the Society has nominated Prof. G. M. Bennett as honorary secretary and Mr. F. P. Dunn as treasurer, for election at the annual general meeting on March 30. The Council has also accepted with regret the resignations of Prof. F. Challenger and Dr. S. Glasstone from the office of local representative for Leeds and Sheffield respectively, and has invited Dr. J. W. Baker (Leeds) and Sir. A. W. Chapman (Sheffield) to fill these vacancies.

PROF. OTTO LOEWI has been appointed by the Fondation Francqui as a visiting professor for eight months to a Francqui chair in the University of Brussels. His address during that time will be: Fondation Universitaire, 11 Rue d'Egmont, Brussels.

PROF. OTTO MEYERHOF, For. Mem. R.S., of the Kaiser Wilhelm-Institut für Medizinische Forschung, Institut für Physiologie, Heidelberg, writes that his address from now on will be Institut de Biologie Physico-Chimique, 13, Rue Pierre Curie, Paris, 5.

DR. ROBERT FEULGEN, professor of physiological chemistry at Giessen, has been elected a member of the German Academy at Halle.

PROF. F. PIETRUSKY, of Bonn, has been elected honorary president of the International Academy for Forensic and Social Medicine.

DR. LOUIS MARTIN, director of the Pasteur Institute of Paris, has been elected vice-president of the Paris Academie of Medecine and M. Gaston Louis Ramon, sub-director of the Institute, has been created a Commander of the Legion of Honour for his work on immunization against diphtheria and tetanus and combined inoculations.

ON the occasion of the International Water Exhibition and the inauguration of the Albert Canal, the eighteenth session of the Congress, known as the Journées médicales de Bruxelles, will be held at Liège on June 24–28 under the presidency of Prof. Ernest Renaux, member of the Belgian Royal Academy of Medicine. Further information can be obtained from the general secretary, Dr. René Bekkers, 141 rue Belliard, Brussels.

THE Annual Congress of the Ophthalmological Society of the United Kingdom will be held at the Royal Society of Medicine on April 20–22, when the subject for discussion will be the problems of refraction.

THE University of Groningen will commemorate on April 29–30 the one hundred and fiftieth anniversary of the death of Peter Camper, the celebrated physician, anatomist, obstetrician and artist, who was for ten years a professor at the University.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 166.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The 'Thumb' of the Giant Panda

SOME reference has been made in the daily Press, during the past few days, to the extraordinary grasping power possessed by the giant panda at the London Zoological Gardens. It has been stated that "It is now seen that the fingers are used in conjunction with a thumb on each hand to grasp the bamboo. The thumbs are not tapered like the fingers. They are broad stumps, but they are connected with adductor muscles, by means of which they can be brought into contact with the fingers".

True opposable thumbs, capable of grasping, are possessed only by animals that have never ruined their grasping arboreal hands by using them to support the body weight in terrestrial pronograde progression. The giant panda is apparently a non-arboreal, quadrupedal pronograde, and should it have retained a truly opposable thumb, it would be a very remarkable circumstance: should it have re-developed an opposable thumb (for the purpose of grasping bamboo shoots) from one that had lost its structural basis of opposability, it would have performed a miracle. Not even the giant panda could be expected to reverse structural evolution to the extent of making an opposable, grasping thumb from one in which all the structural adaptations to this functional end had been lost. But the giant panda has done something that is almost equally remarkable. It has developed a new and thoroughly efficient pseudo-thumb. For the 'thumbs' which are 'broad stumps' are not thumbs at all, though they have attained, with great perfection, to their functional role. In addition to the pseudo-thumb, there is a true first digit, followed by four other digits: and the true thumb is in no way differentiated from (but is smaller than) the rest of the digits.

Upon the radial side of the carpus, there is developed in many mammals a sesamoid bone corresponding to the pisiform upon the ulnar side. In the true bears, the radial sesamoid is a small nodular mass; in the giant panda it has been developed into an elongated bone articulating with the scapho-lunar and projecting from the radial side of the hand after the fashion of a true thumb. Moreover, many of those muscles, which in normal mammals are inserted to the first digit, gain their insertion, in the giant panda, into the radial sesamoid, which thus usurps the place of the true thumb and simulates all its movements. The anatomical details of this curious adaptation will form the subject of a communication to the Zoological Society of London, to the authorities of which I am indebted for the opportunity of dissecting the fore-limb of this animal. In the meantime, it seems worth while to record this curious example of adaptation, by which an animal in which the thumb had lost its structural modifications for opposability and general mobility, has created a new and extremely serviceable 'thumb' in response to a special need in its economy. It would seem that what is commonly known as Dollo's Law of the Irreversibility of Structural Evolution was sufficiently rigid to make the creation of a new mobile thumb an easier matter than the remodelling of one that had lost its original structural adaptation to mobility. But it is surely a very definite triumph that the giant panda has been able to make so perfect a new thumb as to deceive those who have admired the perfection of its grasp.

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The Electronic Charge

WE have made modifications in the drop method for measuring the electronic charge, e, which enable a higher degree of accuracy to be obtained.

The method is also convenient for measuring the number of elementary charges, n, which are carried by a drop when it is detached from a volume of oil. Results of such measurements are given below.

The method used is that of H. A. Wilson, modified by (1) the use of a horizontal electric field; (2) recording photographically the motion of the drop.

Following Millikan, to reduce the evaporation of a drop, one of oil is used. The drop moves in air between the vertical plates of a condenser. During the first part of its motion it is acted upon only by its weight; then an electric field, X, is established, and a horizontal force, neX, acts too on the drop. If v is the vertical, and u the horizontal component of its velocity, and if Stokes's law applies, then

$$ne = k\mu^{3/2}v^{1/2}u/X,$$

where $k = 9\pi\sqrt{2}/\sqrt{g(\rho-\sigma)}$, and μ is the viscosity of the air at the temperature of the experiment. This value of e requires correction, according to the method devised by Millikan, to allow for the departure from Stokes's law.

The drops of apiezon and castor oil used have had a diameter, $2a$, of 0·0002–0·0010 cm. They are illuminated by a carbon arc with a dark-ground condenser designed for the purpose. The exposure is 0·0008 sec. at intervals of 1/25 sec. A low-power microscope objective and a fine-grained photographic plate is used. An example of a photograph obtained is reproduced in Fig. 1.

With this method, displacements correct to about 0·00003 cm. can be measured, and if the velocity is 0·3 cm./sec., intervals of time measured are correct to 0·0001 sec. It enables the velocities of drops to be measured which, on account of their large radius, move too quickly for accurate visual observation. For these drops, the correction factor to Stokes's law

$(1 + A/pa)$ is more nearly 1 than for smaller drops, and the error in the value of e due to Brownian motion is diminished.

The vertical and horizontal velocities of a drop can be observed, too, with sufficient precision to make possible the verification of the assumptions made in deriving the expression given above. We have in this way detected small errors which have been removed by experimental improvements.

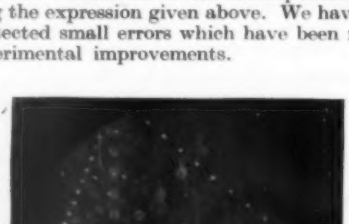

Fig. 1.
PHOTOGRAPH OF DEFLECTED DROPS.

It would be premature to state the value of e which has been obtained in our preliminary measurements, but so far it is slightly lower than that of Millikan. (The increase in his value from $4{\cdot}77 \times 10^{-10}$ to $4{\cdot}8 \times 10^{-10}$ E.S.U. is made necessary by recent determinations of μ for air.)

Drops of oil formed by detachment from the steel wires of a brush are found to be electrically charged.

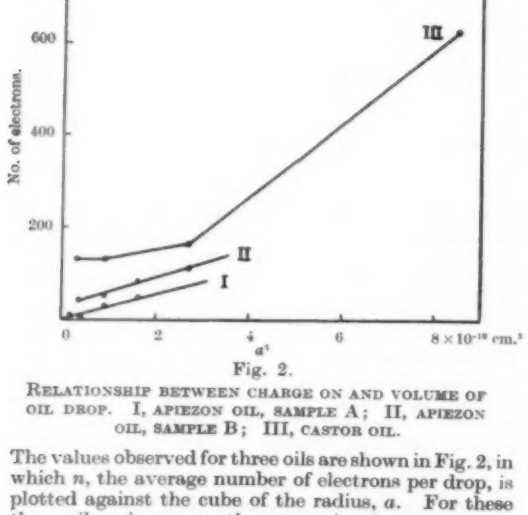

Fig. 2.
RELATIONSHIP BETWEEN CHARGE ON AND VOLUME OF OIL DROP. I, APIEZON OIL, SAMPLE A; II, APIEZON OIL, SAMPLE B; III, CASTOR OIL.

The values observed for three oils are shown in Fig. 2, in which n, the average number of electrons per drop, is plotted against the cube of the radius, a. For these three oils n is apparently proportional to a^3. Drops of castor oil to which more than 1,000 electrons were attached have been photographed. Long-chain molecules of glycerides of ricinoleic acid, $C_6H_{12}.CH(OH).C_9H_2 : C_8H_{12}.COOH$, and of the free acid are present in castor oil. Presumably a number of these chain molecules are broken in the formation of a drop, thus causing it to be charged.

We are indebted to Mr. T. P. Gill for valuable assistance in the electrical measurements.

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The Expanding Universe and the Origin of the Great Nebulæ

Prof. G. Gamow and Dr. E. Teller have propounded[1] an interesting view of the genesis of the nebulæ, but I doubt if either their arguments or their calculations can survive criticism. In brief, they think that the average density of matter in the present universe is about 10^{-30}; that matter of this density, spread uniformly as a gas through space, could only condense into the present nebulæ if the gas-molecules were at a temperature of "several million degrees, which seems to be very unlikely"; that for condensation to have taken place in the past, internebular distances must have been less than now by a factor of about 1,000. "Since the present average distance between the nebulæ is just about 1,000 times larger than their diameters, we conclude . . ." and so on. Their whole cosmogony is based on the supposed equality of these two factors of 1,000. I believe both to be wrongly calculated.

The average internebular distance is about 2,000,000 light-years[2], but the average diameter of a nebula[3] is certainly more than 2,000 light-years. The true ratio here is probably nearer to 100 than to 1,000.

Recent investigations by Sinclair-Smith, Holmberg and others suggest that Hubble's estimate of 10^{-30} for mean density (which was anyhow only given as a lower limit), is emphatically on the low side. The average nebula appears to have a mass of at least 10^{11} suns. This gives a mean density, for nebular matter alone, of $2{\cdot}5 \times 10^{-29}$, which reduces the needed contraction from 1,000 : 1 to 40 : 1. But this is not all; in calculating the criterion for the formation of condensations, the authors neglect the gravitational field of all uncondensed matter outside the incipient condensation. My own calculations[4] indicate that this introduces a further wrong factor of $8\pi^2/9$, or about 9.

When all this is put straight, I find that the present universe, as it now stands, could be formed by the condensation of a gas with a 'thermal' velocity of about 20 km. a second. To obtain this velocity, we need not postulate gas molecules (!) "at temperatures of several million degrees"; we can get it from hydrogen atoms at 19,000° C., or from free electrons at −260° C., or from a mixture of atoms and electrons at any temperature we choose between −260° C. and 19,000° C. The range is so wide that nothing can be ruled out as impossible.

The range of universes which could be formed by gas-condensation would appear, then, to include the actual present universe. If so, we cannot form any estimate of the epoch, or any picture of the manner, in which our universe was formed, from the considerations proposed by Gamow and Teller.

I believe other objections can be brought against their arguments without being hypercritical. For example, in the expanding universe of the theory of relativity, material particles gain kinetic energy during the process of expansion. But this gain must

not be included in the equation of energy; if it is, there is no longer conservation of energy. This makes me think that the authors' arguments about velocity of escape are invalid.

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[1] NATURE, 143, 116 (1939).
[2] Hubble, "The Realm of the Nebulæ", 189.
[3] *Loc. cit.*, 178.
[4] "Astronomy and Cosmogony" (second edit.), 348.

Glaciological Results of the Jungfraujoch Research Party

LAST spring a note was published in NATURE on the aims of our expedition to the Jungfraujoch to study glaciological problems. The working out of our results has now progressed so far that we are able to give a brief account of them.

The main part of the work was concerned with the study of the transition of snow into ice in glaciers, but the results obtained also threw considerable light on the mechanism of glacier flow.

The general scope of the work and results may be outlined as follows:

(1) *Transition of snow into glacier ice.* Specimens of firn and ice were removed from the walls of deep crevasses and artificial shafts in the interior of the glacier. Depths one hundred feet below the surface were explored. The samples were examined in a laboratory which had been excavated in stationary ice at the Jungfraujoch. The temperature of the laboratory remained at about $-4°$ C. throughout the summer. The change in density with depth was determined at various points between the source and firn line of the Great Aletsch Glacier. From these results it was possible to draw a profile of the density distribution in the glacier and to define a transitional plane between firn and glacier ice. Usually the density increase on passing from early firn to glacier ice was found to be a gradual one. However, a transition point between the two could be distinguished at a density of about 0·84, since here the hitherto porous firn becomes impermeable to water by the freezing out of descending melt water and by a slow process of settling. Measurements indicate that the latter process is an important factor in increasing the density.

(2) *Névé temperature.* By means of thermocouples buried at depths down to 30 m., it was found that the winter cold wave penetrated to about 15 m. depth. Below this depth it was concluded that the whole glacier was at the pressure melting temperature. The heating of the firn in summer is attributed to a downward percolation of melt water from the surface and it was found that the rate of temperature rise depended on the firn structure and its permeability to water.

(3) *Crystallographic studies.* Using the standard methods of optical crystallography, the size, shape and orientation of the crystals and the distribution of the air spaces were studied in thin sections cut from specimens which had been taken from the interior of the glacier. A statistical survey of the orientation of a large number of crystals in these sections gave evidence of the presence or absence of any preferred orientation. Although firn near the surface showed orientation due to growth in a unidirectional cold wave, this orientation was observed to disappear gradually at greater depths by the independent movement of firn grains during glacier flow and settling. Preferred orientation of crystals by plastic deformation due to shear was found in several places on glacier tongues.

(4) *Stratification bands.* Two types of bands are distinguishable in the *névé*, (*a*) dirt bands, which form on the surface and represent the boundary between the accumulation of successive years, and (*b*) ice bands, which are also of sedimentary origin; the crystal orientation of these is similar to that of pond ice. Other types of bands are to be seen in glacier tongues; of these the most important are the 'blue bands' which are of tectonic origin. Bands of sedimentary origin are also found in the glacier tongues.

(5) *Glacier flow.* Fundamental differences were observed between the mechanism of flow in the *névé* region and in the ice of the tongue. Measurements of the differential movement in firn together with the crystallographic evidence showed conclusively that flow takes place by the haphazard motion of crystals or small crystal aggregates. Below the firn line, where the interlocking of crystals prevents their relative motion, the glacier flows by plastic deformation and also by laminar movement along thrust planes. Plastic deformation involves the slip of crystals along their basal glide planes and is accompanied by the growth and reorientation of crystals due to a molecular transfer across their grain boundaries.

Full accounts of the work will be published in the near future.

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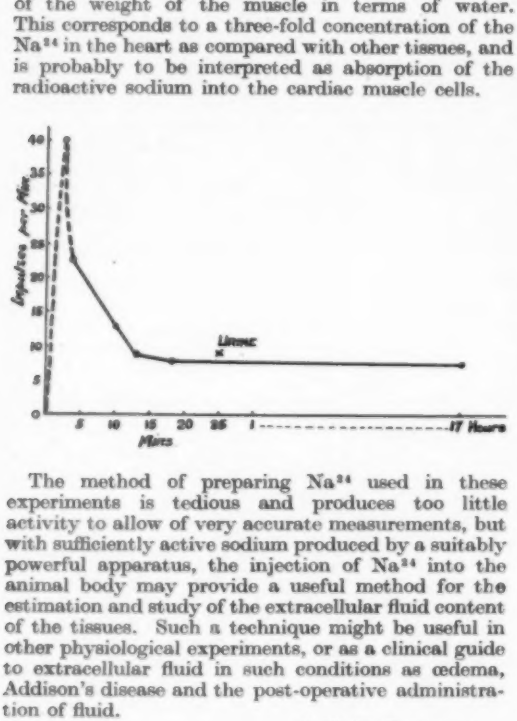
Distribution of Radioactive Sodium after Injection into the Rabbit

RADIOACTIVE sodium has been administered to rabbits in the form of sodium chloride and the subsequent distribution of the Na^{24} investigated by measuring the activity of samples of ashed blood and tissues with a Geiger counter. The radioactive sodium (Na^{24}: 14·8 hours period) was obtained by irradiating magnesium or sodium hydroxide with neutrons from a radon-beryllium source of about 500 mc. The total activity so produced corresponded to 2000–4000 impulses per minute on the counter used for recording.

After intravenous injection of the radioactive salt, the Na^{24} in the blood was found to reach a constant level in about 15–20 minutes (see accompanying graph). A similar constant level was reached in about the same time after intraperitoneal injection. Equilibrium was obtained more slowly following injection of the salt into the colon. Assuming that the sodium is evenly distributed in a fluid medium[1], it is possible to estimate from the ultimate constant level of the Na^{24} in the blood the volume in which it is dissolved. Thus, for example, in one animal (weight 3000 gm.) 22·5 minutes after intraperitoneal injection of Na^{24}, 5 c.c. of blood contained an amount of radioactive sodium corresponding to 15 impulses per minute. The total radioactive sodium in the body at this time, allowing for the overflow into the urine, would have given 2500 impulses per minute. Hence the volume of fluid in which this Na^{24} was dissolved must have been about 830 c.c., that is, 36 per cent of the body weight in water. Similar results

were obtained in the other animals examined, the fluid in which the Na^{24} was dissolved being about 30–35 per cent of the body weight in water.

There is accumulating evidence that most of the sodium of the animal body is distributed outside the cells, so that the volume calculated above may be taken as representing the extracellular fluid content of the rabbit. These results compare favourably with those obtained by other workers by direct chemical analysis of the tissues[2]. Samples of ashed tissues have given similar results; for example, liver contained 35 per cent of its weight of extracellular fluid, muscle 35–40 per cent, etc. In two animals the heart muscle was found to be exceptional, the radioactive sodium present in this tissue after injection being more than that representing 100 per cent of the weight of the muscle in terms of water. This corresponds to a three-fold concentration of the Na^{24} in the heart as compared with other tissues, and is probably to be interpreted as absorption of the radioactive sodium into the cardiac muscle cells.



The method of preparing Na^{24} used in these experiments is tedious and produces too little activity to allow of very accurate measurements, but with sufficiently active sodium produced by a suitably powerful apparatus, the injection of Na^{24} into the animal body may provide a useful method for the estimation and study of the extracellular fluid content of the tissues. Such a technique might be useful in other physiological experiments, or as a clinical guide to extracellular fluid in such conditions as œdema, Addison's disease and the post-operative administration of fluid.

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[2] Fenn, W. O., *Physiol. Rev.*, **16**, 450 (1936).

A Difference of Effect Between the Œstrogenic Hormones and Diethylstilbœstrol

IN a previous investigation[1] it was shown that the œstrogenic hormones and progesterone are able to inhibit the comb-growth action of the male hormone. This action was described as antagonistic. The control determinations, carried out simultaneously, showed that in this case it was a question of a specific activity of the hormones, the mechanism of which is not yet clear. The antagonism shows itself both on injection of the hormone and on smearing on the comb.

After the discovery of the œstrogenic activity of diethylstilbœstrol by Dodds, Golberg, Lawson and Robinson[2] this substance was also investigated as to its antagonistic action (Mühlbock)[3]. By injecting this substance along with androsterone, it was demonstrated that the comb-growth activity could be suppressed in the same way as with œstradiol. No antagonistic action was observed, however, with diethylstilbœstrol when it was smeared on the comb. Thus in this way it is possible to demonstrate biologically a difference between the œstrogenic hormones and diethylstilbœstrol. It has not yet been explained why diethylstilbœstrol fails to act when applied to the comb; possibly it is not resorbed.

This biological difference between the œstrogenic hormones and diethylstilbœstrol, besides being of theoretical interest, may also be of practical importance in so far as this method makes it possible to establish what type of substance is responsible for the œstrogenic action. For practical purposes, only the following œstrogenic substances come into question: œstrone, œstrone benzoate, œstradiol and œstradiol benzoate. Hence these œstrogenic substances were examined as regards their antagonistic activity and compared with diethylstilbœstrol.

Experimental method. When 0·4 γ of testosterone dissolved in 0·2 c.c. of oil is smeared twice daily (0·1 c.c. each time) for four days on the comb of a capon, on the average, a comb-growth of about 15 per cent is observed in five days. Six capons were always taken for each experiment and six other capons always served as controls. The combs were measured by the photo-electric process worked out in the Amsterdam Institute[4]. In the actual experiments the œstrogenic substances were smeared together with 0·4 γ of testosterone on the combs of the capons.

In order to bring about a complete suppression of comb-growth activity of the testosterone, 5,000 International Units of the œstrogenic hormones are sufficient.

Daily dose in 0·2 c.c. oil	Average percentage comb-growth in 6 capons after 5 days	Result
Experiment 1		
0·4 γ Testosterone	+ 13	Control
0·4 γ Testosterone + œstradiol 5,000 I.U. = 250 γ	0	Total suppression
0·4 γ Testosterone + œstradiol benzoate = 650 γ	+ 3	Total suppression
0·4 γ Testosterone + œstrone 5,000 I.U. = 500 γ	− 7	Total suppression
0·4 γ Testosterone + œstrone benzoate = 2,000 γ	− 4	Total suppression
0·4 γ Testosterone + diethylstilbœstrol 5,000 I.U. = 250 γ	+ 12	No suppression
Experiment 2		
0·4 γ Testosterone	+ 21	Control
0·4 γ Testosterone + diethylstilbœstrol 10,000 I.U. = 500 γ	+ 18	No suppression
0·4 γ Testosterone + diethylstilbœstrol 20,000 I.U. = 1 mgm.	+ 21	No suppression

In the accompanying table, only one example of each œstrogenic substance is given. In the first experiment with testosterone, we obtained an average comb-growth of 13 per cent. The same comb-growth (12 per cent) was obtained when simultaneously with testosterone diethylstilbœstrol was smeared. Contrary to this result, all the other œstrogenic substances suppressed the comb-growth

completely. Thus this method of working provides us with the possibility of distinguishing these two groups of substances biologically from one another. The cause of the different action of diethylstilbœstrol is at present being investigated more closely.

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[2] Dodds, Golberg, Lawson and Robinson, NATURE, **141**, 247 (1938).
[3] Mühlbock, *Acta Brevia Neerland.*, **9**, No. 1 (1939).
[4] Comprehensive description by Freud, *Abderhaldens Handbuch*, **5**, 3B, 1667 (1938).

Cycle of Responsivity of Castrated Albino Mice and of Human Beings to Œstrone Injection

In her recently reported observations on seasonal rhythm in the responsiveness of castrated mice to injections of œstrone, Dr. J. Duszyńska states that the response is more than three times as great in May as in November[1]. She raises the question as to whether a similar rhythm exists in the human.

Such an observation, of course, is somewhat difficult to correlate with studies made on the human female whose gonads are still present and functioning cyclically. There does appear to be a seasonal rhythm, however, in the values for blood œstrogens found in normal males[2]. Moreover, it is much more common to find high values for blood œstrogens[3] in pregnant women in the late winter and spring than in the summer, in this part of Canada at least. This can be correlated with an increase in the late winter and a decrease in summer in the incidence of pathological states closely related to high values of blood œstrogen, such as certain pregnancy toxæmias and abortion. We have postulated, on account of the reciprocal relation existing between ingested vitamin E and the blood œstrogen, that this is due to the seasonal tides in intake of this vitamin. In administering anti-œstrogens it is essential to take this variation into consideration[4].

If Duszyńska means that only one third as much œstrogen has to be administered in May as is required in November in order to produce the same degree of response, her data parallels ours.

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[2] Shute, E. V., *Amer. J. Ob. and Gyn.*, **35**, 639 (1938).
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Effect of Zinc on the Iodine-Consuming Power of Insulin

THE duration of the blood sugar lowering action of insulin injected by the subcutaneous route is prolonged by the addition of zinc salts[1]. The action of crystalline insulin containing zinc is of longer duration than that of an equal number of units of a preparation free from zinc.

This zinc effect is not found when rabbits are used, since apparently no difficulties are encountered in the assay of insulin of varying zinc content by the widely used rabbit method. Experiments with diabetics, however, have shown that this zinc effect is readily demonstrable[2,3], and rather severe clinical disturbances were observed when a crystalline insulin was substituted for a zinc-free preparation (insulin containing less than 0·1 mgm. zinc per 1000 units is considered zinc free)[4].

As the onset of the action of insulin appears to be retarded in the presence of zinc[3], one is led to the assumption that the insulin cannot become fully active unless the zinc, which shields an active part of the molecule (by the strong hydration of the zinc ion ?), is split off.

With the view of finding out whether zinc exerts a protecting action also *in vitro*, I examined the action of iodine on insulin. The iodine-consuming power of insulin was measured at *p*H 7·2 in the presence of calcium, aluminium, cadmium, zinc and lead.

It was found that the addition of zinc (and to a smaller degree probably also of cadmium) decreased the iodine consumption. Calcium, aluminium and lead showed no effect. The magnitude of this zinc effect is a function of the physiological activity of the insulin preparation used. These findings suggest the possibility of a purely chemical explanation of the physiological effect of zinc on the action of insulin. Moreover, a chemical method of assay of insulin appears to be made possible by the fact that my experiments showed the existence of a definite relation between the iodine-consuming power of insulin and its physiological action as measured in units.

Details of the experimental results will be published elsewhere.

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[1] Scott, Fisher, *J. Pharmacol. and Exper. Therap.*, **55**, 206 (1935).
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Chlorophyll Formation and Development of Photosynthetic Activity in Juvenile Leaves of Mango (*Mangifera indica*)

THE question how far the development of photosynthetic activity is concomitant with chlorophyll formation has not been definitely answered; the investigation in higher plants being mainly along two lines: (1) relationship between rates of photosynthesis and chlorophyll formation in leaves in different stages of development; and (2) relationship between the two during the greening of etiolated seedlings.

(1) Willstätter and Stoll[1] observed that in the developing leaf both the chlorophyll content and photosynthetic rate increase but not in any definite proportion. Singh and Lal[2] noted that mature and old leaves, although containing a greater amount of chlorophyll than the younger, fail to show a proportionate increase in the photosynthetic rate. Briggs[3] finds in seedlings developing a specialized photosynthetic organ different from the storage, the activity is not developed until some time after germination, while in those with the storage and the first assimilatory organ the same, there is no lag between the development of chlorophyll and that of full photosynthetic activity.

(2) Irving[4] concludes that chlorophyll is not a limiting factor in the earlier stages of the developing

assimilatory organs ; the beginning of photosynthetic activity being controlled by some other component part not developed by illumination as rapidly as the green pigment. Briggs[5] found that the assimilatory power of young shoots depends on their age rather than on chlorophyll content.

Emerson[6], using *Chlorella*, demonstrated that chlorophyll content was a limiting factor. However, as mentioned previously[2], *Chlorella*, being a unicellular organism with the simplest mechanical arrangement for carbon dioxide diffusion, is not strictly comparable with multicellular leaves.

The results recorded by us with respect to chlorophyll formation, photosynthetic activity and absorption of radiant energy at different stages of juvenescence in the leaves of the perennial tropical plant, mango, appeared to throw interesting light on the question. Photosynthetic rate and chlorophyll content were determined by methods outlined before[2,7] and absorption of radiant energy by a new method to be described elsewhere.

In the earliest stage, the primordial (leaf bud), the true assimilation rate (mgm. of CO_2 per 10 gm. fresh weight) is 0, the chlorophyll content (mgm. per 10 gm. fresh wt.) being 0·12. After three days, the assimilation rate rises to 0·9 and chlorophyll content to 1·10. The assimilation number of 0·82 at this stage increases to 6·17 at the tenth day, when assimilation rate is 18·5 and chlorophyll content 3·00. On the twenty-fifth day, the assimilation rate is 51·6, chlorophyll content 14·10 and assimilation number 3·65. Thus assimilation rate increases continuously but not in proportion to the chlorophyll content as evidenced after the tenth day by decreasing assimilation numbers. The leaves until the tenth day show increasing shades and after that decreasing shades of red coloration, being completely green only at the twenty-fifth day. On the thirtieth day, that is, the mature stage of the leaves, the assimilation rate falls to 48·4 although chlorophyll still shows an increase (16·50 mgm.). At the earliest stage, 0·5 per cent of the incident energy in the red region of the spectrum and 0·3 per cent in the blue only are absorbed ; at the stage of active photosynthesis, that is, the tenth day, the absorption being 8·0 per cent and 4·1 per cent, and at the mature stage, that is, the thirtieth day, 27 per cent and 18·4 per cent in the red and blue regions respectively.

There is thus no proportionality between the development of photosynthetic activity and chlorophyll formation. According to Irving[4], probably the youngest leaves (until the third day), although possessing chlorophyll, lag behind in some other part of the photosynthetic machinery. The latter, as suggested by Willstätter and Stoll[1], may be then having a controlling influence resulting in increasing assimilation number, and after the tenth day when the red colour is disappearing this factor may be less active.

On considering the above results in conjunction with the findings of Briggs[3], the juvenile leaves of the perennial mango appear to conform to the type of those of the seedlings in Briggs's experiments, where the storage organ is different from the first assimilating organ ; the photosynthetic activity in consequence lagging behind chlorophyll formation. The lack of immediate necessity for active photosynthesis by these young leaves is evidenced by the fact that at this stage the mature green leaves of the previous season are still present with active assimilatory power.

The evidence of a stage in the development of a leaf with no photosynthetic activity, a marked lag in the same as compared with chlorophyll formation and a corresponding lack of absorption of photosynthetically active components of radiant energy until the stage of active photosynthesis in a perennial plant like the mango, is interesting and appears to bring into unison the conclusions of the two main lines of investigation discussed above.

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[2] Singh, B. N., and Lal, K. N., *Ann. Bot.*, **44** (1935).
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Behaviour of Mature Male Salmon Parr, *Salmo salar* juv. L.

IN a recent account of early and normal sexual maturity in male salmon parr in the Welsh Dee[1], we directed attention to the possibility of these young mature males behaving differently in their river movements from other young parr of the same age, immature males and females. The absence of mature males from one tributary, Hirnant Brook, at the time of examination indicated that they might have migrated ; but as the sample was a very small one consisting of eleven individuals, the discriminating behaviour of the mature male could only be regarded as a possibility. In November, however, significant information was obtained. Pure samples of mature male parr were found on November 14, 15 and 16—coincident with the ascent of the last batch of adult spawners up the River Alwen—to have collected in numbers (twelve, sixteen and twenty respectively) in the stream-like race or overflow from a set of salmon-keeping tanks built into the bank of the River Alwen at Pont Barcar Weir. The race runs alongside the river and is separated from it only by a revetment wall, around the lower end of which the race runs into the river with a fall of a few inches.

No other parr than these forty-eight mature males, all of which were running ripe, were found in the race. But it may be mentioned that, when the earlier batches of salmon were 'running', salmon parr were occasionally found temporarily stranded in their efforts to negotiate one side of the weir at Pont Barcar. It would appear, therefore, that either the mature males are much more active than other parr, or that mature parr had approached the weir on an upstream migration and had entered the race in numbers as a promising easy upstream path.

An alternative or additional attraction of the race may lie in the fact that large mature females and males were being stored in the tanks from which the race water was derived. If mature male parr are attracted to the mature females chemotactically, they would tend to accumulate in the race while females were in the tanks.

A solution to the problems may be found experimentally in the future, but it is clear that the movements of mature male parr at spawning time can be different from those of other parr, and that upstream

or downstream migration and positive chemotaxy may possibly occur. Differential movement in mature male parr helps to account for their congregation on redds with spawning females. Many unpublished observations on the latter phenomena have been communicated to us since the publication of the paper noted above. Definite proof of the actual spawning of male parr with adult females is still nevertheless awaited, however probable it may seem. The probability is perhaps rendered greater by the fact, noted by Pearson[2] (after Worth), that in another anadromous fish, the striped bass, *Roccus saxatilis* (Walb.), 20–50 young males each of not more than 2 lb. in weight may spawn with *one* large 5–20 lb. female in the rapid rivers which this species frequents for spawning.

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Thermostatic Action of Textile Fibres

THE part played by heat evolved during absorption of water vapour by a porous body on rate of diffusion of water vapour into the body has been examined mathematically by P. S. H. Henry[1]. In the laboratories of the Wool Industries Research Association similar problems have been studied, and experimental results obtained indicate that in addition to control of rate of conditioning (establishment of moisture equilibrium), absorption of water vapour by fibres and the attendant evolution of heat have an important significance in determining rate of propagation of temperature changes through fabrics. This effect is such that it cannot fail to have a bearing on the relative hygienic properties of textile fibres.

Our experiments have eliminated diffusion through air by evacuation, and under these conditions the time-regain (percentage moisture content relative to dry weight) curves obtained can be accounted for by change of temperature of the fibres alone; that is, the time required for equilibrium-regain to be attained when relative humidity is changed is small compared with the time required for appreciable heating or cooling of the fibres.

The time required in air at atmospheric pressure for change of regain is also small enough to be taken as zero compared with that required for any thermal change when allowance is made for diffusion effects. In normal atmospheres, water vapour pressure is roughly constant; for example, it is roughly the same indoors and outdoors on any given day. Consider a fabric taken from a hot to a cold region in this atmosphere. When the fabric temperature decreases, the relative humidity relative to the fabric increases, since the water vapour pressure is constant, and it begins to absorb water vapour. Heat of absorption is evolved and this tends to bring the fabric back to its original temperature. Resistance to temperature change from this source is very much more than can be obtained from ordinary diffusivity, because the specific heat factor is virtually replaced by a latent heat one, and the effective diffusivity becomes small.

This of course is only true if the fibres absorb water rapidly, which most textiles used for clothing are able to do in virtue of the small diameter of their fibres. Differences between their thermostatic action will be determined by the *quantity* of water absorbed for a given change in relative humidity.

The relative importance of specific heat and regain may be readily appreciated from the example of a kilogram of wool fabric taken from an indoor temperature of 18° C. and 45 per cent relative humidity to an outdoor one of 5° C. and 95 per cent relative humidity. It must lose 4,000 calories because of the specific heat of the fibres, but it must lose 100,000 calories because of change in regain from 10 to 27 per cent before its temperature attains the lower value. The latter is as much heat as a human body normally loses in one hour, and shows the exceptional thermostatic action that textile fibres can have in ordinary atmospheric conditions provided they absorb water vapour sufficiently rapidly.

The importance of water vapour to the thermostatic action of textiles has been demonstrated in these laboratories by comparison of the time required for propagation of temperature changes through fabrics in normal atmospheres and in dry air. Details of this work and its theoretical and practical implications will be published elsewhere.

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Structure of Metals under Deformation

IN recent work on the deformation and fracture of metals under static and fatigue tests, it was shown that originally perfect grains were systematically dispersed into crystallites. The interesting feature of the process was the appearance of a lower limiting size, about 10^{-5} cm., below which the crystallites could not be broken down further by the modes of deformation employed[1].

Other work has now been carried out on metals of high purity under greater degrees of deformation than those occurring in the usual mechanical tests, and this work, whilst in general confirming the above principle, has brought out the following new points. In the first place, the lattice size, defining the interatomic distance within the crystallites, is not necessarily the same as that of the original perfect grains. In pure copper, the lattice expands. The effect may be measured easily by the X-ray diffraction spectrum of the metal, and is illustrated by the accompanying photographs obtained by a back-reflection method specially adapted for precision work. Fig. 1 is from the initial annealed material; this photograph corresponds to one given when the incident X-ray beam covers sufficient large grains to give continuous spectral lines, and is reproduced merely to show what the relative sharpness and positions should be of the characteristic (400) α_1, α_2 doublet and (331) β lines under the experimental conditions employed. Fig. 2 is from the same specimen after 81 per cent reduction in thickness by cold rolling; this shows clearly that apart from the great diffusion of the lines (due to the onset of the crystallite formation), there is a bodily shift of the (400) line to the right; the effect may be seen conveniently by eye on noting the difference in separation of the (400) line from the (331) line, the latter being much less affected as it occurs at a smaller diffraction angle. The direction of the shift corresponds to an *increase* in lattice size.

A further point is illustrated by Fig. 3, obtained after continuing the reduction of the specimen to 90 per cent. It will be seen that the extra working has caused a reversion of the lines towards their original positions, and, at the same time, has produced some decrease in the breadth of the lines. This dual change corresponds to partial recovery in internal deformation and overall size of the crystallites. Actually, these effects are to be noted at a much earlier stage, after some 20 per cent reduction; then, further working of the partially recovered state again leads to the abnormal deformation, and this in turn recovers, the structure varying between the two

RELATIVE SHIFT AND DIFFUSION OF (400) AND (331) X-RAY LINES OF COPPER ON DEFORMATION.

limits according to the balance at the moment of examination. This result indicates directly that the greater breakdown represented by Fig. 2 is in unstable equilibrium, whereas the partially recovered state is comparatively stable, and thus gives a meaning to the lower limiting size referred to in the earlier work.

These changes in structure may have a bearing on the mechanism, still to be elucidated, of the formation of the first cracks which precede and precipitate failure of a metal under strain, for it is reasonable to expect that the change in volume of the crystallites as they are formed along the slip bands will produce an internal stress tending to separate the neighbouring less deformed regions.

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[1] Gough, H. J., and Wood, W. A., *Proc. Roy. Soc.*, A, **154**, 510 (1936) Wood, W. A., *Trans. Far. Soc.*, **31**, 1248 (1935).

Differential Threshold for Viscosity

IN the course of some experiments on the capacity of the human senses to distinguish certain physical properties of colloidal materials, we have had occasion to determine the differential threshold for viscosity, using truly fluid bitumens* having viscosities of the order of 10^6 poises at 18° C.

Thirteen subjects were chosen having widely different experience and training. The samples of bitumen were presented in pairs to each of them with a request for a report as to which sample, if either, was the softer. The samples were squeezed by the subject under water kept at constant temperature. The thirteen subjects between them judged twenty-five pairs of bitumen samples thirty times in all. The samples differed from each other by 0, 7·5, 15, 22·5 and 30 per cent in viscosity. The viscosities were determined by the method of rheograms, slightly modified[1].

There was no significant difference in ability to distinguish viscosities between subjects differing in technological experience, scientific training and general education, although it is possible that age and sex may have had a very slight effect.

The results from the different subjects are combined in the accompanying table:

	Pairs differing in viscosity by:				
	0%	7·5%	15%	22·5%	30%
% correct ..	22	50	63	71	80
% given as equal ..	22	23	20	15	12
% given in reverse order	—	27	17	14	8

This table shows that the percentage of correct judgments becomes significantly above 50 per cent for a viscosity change of about 10 per cent, and reaches an 80 per cent level at a difference of about 30 per cent.

Experiments on the threshold for shear modulus in elastic materials are in progress. Details will be published elsewhere.

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* We are indebted to the Limmer and Trinidad Lake Asphalt Co. Ltd., for their kindness in supplying these samples.

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Excitation of Nebular Lines

THE note which was added in proof by Menzel to his letter in NATURE regarding the effect of collisions on the intensities of nebular lines[1] prompts me to make the following remarks. In presenting the results to which he refers to the San Diego meeting of the Astronomical Society of the Pacific last June, I pointed out that a probable reason for the increase in intensity with pressure of the forbidden transitions in nitrogen is that the rate of production of the metastable states increases more rapidly with pressure than does the rate of de-excitation. It is quite probable that the process of excitation of the metastable nitrogen molecules and atoms in the afterglow is a much more complex process than the production of excited states in nebulæ.

Regardless of this difference, however, it seems that Menzel's use of my experiments as observational proof of the points raised in his letter is a proper one. In fact, experiments at higher pressures and in smaller tubes have resulted in even higher relative intensities for the metastable transitions than those reported last spring. It is gratifying to see that my prediction of the possible astrophysical interest of these results has already been justified.

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[1] Menzel, D. H., NATURE, **142**, 644 (1938).

Conversion of Vitreous and Monoclinic (α) Selenium to the Hexagonal Modification

SELENIUM is known to exist in several stable allotropic modifications, of which the structures of the hexagonal and the monoclinic varieties (α and β) have been determined by Bradely[1] and Klug[2] respectively.

Prins and Dekeyser[3] have investigated the gradual conversion of vitreous or amorphous selenium into the hexagonal variety at high temperatures and have also studied the influence of tension on this conversion. From their experiments they concluded that :

(*a*) The transformation of vitreous selenium into the hexagonal variety may take place at as low a temperature as 60° C., if a thread of vitreous selenium is kept under tension at that temperature.

(*b*) In the absence of tension, the crystallization does not take place below 73° C. The tension, therefore, helps the devitrification of vitreous selenium; and the fact that the degree of crystallization is most marked in the surface layers of a heated selenium stick and gradually becomes less in the deeper layers has also been suggested by them as due to the presence of mechanical stress, already present in the surface layers owing to the 'quenching' method of its preparation.

In the course of our investigations on selenium, we have obtained results which in many respects deviate from those of the previous authors. We find that, if thoroughly powdered specimens of vitreous selenium be maintained at a temperature even as low as 43° C., devitrification of the specimen sets in and gradually progresses with the period of heating, and after a considerable period, say about two weeks, a complete transformation into the hexagonal variety is clearly indicated by the appearance of only sharp diffraction rings on a clear background in its X-ray powder diagram. The powder-pattern obtained in this final stage is reproduced in the accompanying figure (taken with a hemicylindrical camera).

In the experiment mentioned above, we used powdered sticks of vitreous selenium; the diffracting specimen evidently consisted mostly of particles lying in the deeper layers or in the body of the sticks, where the material is supposed to be free from any mechanical stress. Thus the experiment shows that even in the absence of tension, crystallization of vitreous selenium is possible at 43° C., if not at still lower temperatures. Insufficient period of heating the specimen is undoubtedly the cause of failure of the previous authors[3] to detect the crystallization, which is extremely slow at lower temperatures.

In the case of monoclinic (α) selenium, we also find that the transformation into the hexagonal variety is quite rapid at 100° C. and may be detected after 24 hours of heating, whereas the same process is so slowed down at 80° C. that it cannot be detected before several days have passed.

Experiments are in progress to determine the lowest temperature at which these transformations take place. We are of opinion that in every case of monotropic structural transformation there is a critical temperature, below which the transformation in question cannot take place. At this temperature the molecules of the substance acquire the mobility which is required for their correct marshalling in the new structure.

A rise of temperature in all these cases increases the time-rate of conversion and thus minimizes the time required for the complete conversion of the whole specimen. Another example of this type of monotropic change which has been thoroughly studied by one of us[4] is the conversion of Sω or white sulphur into Sα or orthorhombic sulphur. Here both Sω and Sα are the two different crystalline phases of sulphur.

Results of the investigation on selenium will be published in more detail in the *Indian Journal of Physics*.

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[1] Bradely, *Phil. Mag.*, 48 (1924).
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Spectrum of Potassium Deuteride

A PRACTICALLY uncontaminated KD spectrum was obtained in an arc between potassium (negative) and nickel (positive) electrodes burning in a deuterium atmosphere of 50–30 cm. mercury pressure, and was photographed in the first order of a 15-ft. grating spectrograph having a dispersion of 3·7 A. per mm.

In the strongest part of the many-lined spectrum between 4300 A. and 5100 A., the $v'' = 0$ progression bands $7 \rightarrow 0$, $8 \rightarrow 0$ . . . $20 \rightarrow 0$ of the KD $^1\Sigma \rightarrow {}^1\Sigma$ system were found and analysed. At this dispersion, overlapped lines are still numerous and reach up to half the number of lines (60–80) in each band.

The rotational functions of both upper and lower states are anomalous in having a maximum in $\Delta_2 T_r/4J + 2$ at about $J = 20$, and $T_r(v,J)$ must be expressed by terms with positive D_v, negative F_v, etc. However, this point should be examined with a larger dispersion, and preliminary values of rotational constants were calculated according to the usual three-term formula adjusted to the $J > 20$ regions. B'_v can be given by $B'_v = 0{\cdot}673_7 + 0{\cdot}00391\,(v'+1/2) - 0{\cdot}000281\,(v'+1/2)^2$ within $\pm\ 0{\cdot}005$, $D'_v = -\ 1{\cdot}4 \times 10^{-5}$, and $B''_v = 1{\cdot}641$, $D''_v = -\ 1{\cdot}8 \times 10^{-5}$.

As the result of vibrational analysis, null-lines of the observed fourteen bands, evaluated from small

	KD upper state	KH upper state	ρ^2
ω_e'	180·26	254·5 (Almy and House[1]) 240·18 (Hori)	0·5017 0·5633
B_e'	0·673,	1·344 (Almy and House) 1·311 (Hori)	0·5013 0·5139
		Theoretical	0·5129

J lines to minimize the possible errors in computing rotational energies, can be expressed by

$$\nu_0^{v'},0 = 19{,}229 + 180{\cdot}26\,(v'+1/2) + 2{\cdot}204,(v'+1/2)^2 - 0{\cdot}05281\,(v'+1/2)^3,$$

within $\pm$ 2 cm.$^{-1}$. Here again the vibrational function $G'(v)$ is characterized by positive x_e. From the above given constants the isotope coefficient ρ comes out as indicated in the table.

Further analysis of the system is under way and will be published in the *Scientific Papers* of this Institute.

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[1] Almy, G. M., and House, C. D., *Phys. Rev.*, **42**, 243 (1932).
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Points from Foregoing Letters

THE movable 'thumb' of the giant panda, which it uses for the purpose of grasping bamboo shoots, is not a true first digit, writes Prof. F. Wood Jones. The actual thumb of the panda, as of all animals which use all four limbs for supporting the body on the ground, has lost its movability and the animal has developed a new movable digit, rather than reverse its structural evolution (Dollo's law).

A modified method for determining the electronic charge on an oil droplet is described by Prof. T. H. Laby and V. D. Hopper. A horizontal electric field is employed and the movement of the droplet is recorded photographically, so that a displacement of 3×10^{-5} cm. can be measured. Experiments of a preliminary nature indicate for the electronic charge a value slightly lower than that found by Millikan.

Sir James Jeans criticizes the assumptions of Gamow and Teller in their discussion of the genesis of the great nebulæ. He concludes that the universe as it now stands could be formed by the condensation of a gas with a 'thermal' velocity of about 20 km./sec., that is, from a mixture of atoms and electrons at any temperature between — 260° and 19,000° C.

The volume of extra-cellular fluid in various organs has been calculated by Dr. J. H. E. Griffiths and Dr. B. M. Maegraith from determinations of the radioactivity of blood and tissues of a rabbit after injection of radioactive sodium chloride—assuming that the sodium is mainly distributed outside the cells. They find, however, that a certain amount of radioactive sodium is absorbed by the cardiac muscles.

Dr. O. Mühlbock finds that diethylstilbœstrol, unlike the œstrogenic hormones, does not suppress the comb-growth action of the male hormone, progesterone.

Commenting on Dr. Duszyńska's observation that the response to œstrone in albino mice is three times as great in May as in November, E. V. Shute states that there appears to be a seasonal rhythm in the proportion of œstrogens found in normal males; also the blood œstrogens in pregnant women are greater in late winter and spring than in summer; this can be inversely correlated with the intake of vitamin E.

Dr. E. H. Vogelenzang finds that the addition of zinc decreases the iodine consumption of insulin. The magnitude of the zinc effect is a function of the physiological action of the insulin preparation, and the author believes that it may eventually serve as a basis for the chemical estimation of insulin activity.

Prof. B. N. Singh and J. D. Jha find that in the young leaves of the mango the assimilation rate of carbon dioxide increases continuously but not in proportion to the chlorophyll content. The behaviour is similar to that observed by Briggs in the case of seedlings where the storage organ is different from the first assimilating organ and the photosynthetic activity lags behind chlorophyll formation.

Observations on the movement of mature male parr in the Welsh Dee are reported by G. M. King, J. W. Jones and Prof. J. H. Orton, suggesting that at spawning time such movements can be different from those of other parr, and that upstream and downstream migration and positive chemotaxy may occur.

Rate of absorption of water vapour by wool fibres is rapid when the external restrictions of diffusion and thermal change due to heat of absorption are removed. It is suggested by Dr. A. B. D. Cassie, Dr. B. E. Atkins and G. King that this fact is of importance for the hygienic properties of textile fibres and the propagation of temperature changes through fabrics in ordinary indoor-outdoor atmospheres.

Photographs of the X-ray diffraction spectrum of annealed and of subsequently cold-rolled copper at different stages are submitted by W. A. Wood, showing a relative shift and diffusion of the (400) and (331) lines. These indicate a breakdown into small crystallites, followed by a partial recovery in internal deformation and overall size of crystallites.

By comparing the judgments of thirteen subjects concerning the relative softness of samples of bitumen with the actual viscosity of the samples, Dr. G. W. Scott Blair and Miss F. M. V. Coppen find an 80 per cent correct judgment for viscosity differences of 30 per cent.

Research Items

Ancient Eskimo Houses of East Greenland

OWING to the inaccessibility and dangers of the East Greenland coast it has been infrequently visited by Europeans. The Anglo-Danish East Greenland Expedition of 1935, conducted by Mr. Augustine Courtauld, afforded an opportunity for supplementing previous inadequate archæological information. An account of the excavations of house sites and graves and of the objects found at Skærgaardshalve, Ivnarmiut, I. C. Jacobsens Fjord and Cape Irminger in Knud Rasmussen Land has been prepared by Dr. Helge Larsen (*Medd. om Grønland*, København, **119**, 8; 1938). At Skærgaardshalve, a well-known archæological site, seven ruins were examined. These differed much from one another in shape and in state of preservation. In their interiors they were rectangular in plan, with somewhat rounded corners, and a house passage. They were built entirely of stones, more than one metre thick, which on the inside formed even perpendicular walls up to at times as much as nine courses of flat stones. On the outside the stones lie about loosely, giving the impression of a random heap of stone. The internal dimensions of the house first examined were 2·0 m. long by 2·10 m. broad. Of a different type, in which the greatest length of the structure is at right angles to the passage, was the 'common-house' form, in which two rooms adjoined with a dividing wall. The length of the first example found of this type was 7·5 m. At I. C. Jacobsens Fjord one house proved to consist of three houses, built one within the other. A common-house was evidently the oldest, as well as the largest, containing the others. It is concluded that the size of the habitation was reduced from time to time to meet the needs and convenience, for example, in heating, of a decreasing population. Analysis of the types of houses excavated and of the contained objects leads to the conclusion that they belong to the Inugsuk culture of West Greenland with elements from a later cultural stage in Angmagssalik. Its entry into East Greenland dates probably from the fifteenth or sixteenth century and it probably became extinct in the nineteenth century.

Avitaminoses and Endocrine Glands

B. SURE (*Endocrinology*, **23**, 575; 1938) has investigated the influence of various avitaminoses on the weights of endocrine glands in animals (pigeons and rats). He found that in vitamin A deficiency there was a hypertrophy of the pancreas amounting to 40 per cent. In vitamin B deficiency there was a marked hypertrophy of the thyroids and adrenals. The most noteworthy change in endocrine weights was the marked atrophy of the thymus in vitamin B deficiency which occurred in 100 per cent of the animals. Hypertrophy of the pituitary was found in vitamin B_1 and vitamin B_2 deficiency to the extent of 40 and 25 per cent respectively. Repeated vitamin B_1 depletions of endocrine weights had the following effect: the hypertrophy of the pituitary entirely disappeared; in the thyroid it was reduced to insignificant proportions (9·1 per cent) and in the adrenals from 50 to 20 per cent.

Hypersensitiveness in Experimental Tuberculosis

R. H. FOLLIS, JUN. (*Bull. Johns Hopkins Hosp.*, **23**, 283; 1938) has studied the effect of preventing the development of hypersensitiveness in experimental tuberculosis in guinea pigs as follows. He found that the lesions in guinea pigs infected with tubercle bacilli and prevented from becoming hypersensitive by subcutaneous injection of old tuberculin showed less caseation than those of control animals which developed hypersensitiveness. In some of the non-hypersensitive animals, pulmonary lesions developed which were marked by an extraordinary proliferation of acid-fast bacilli. Since these lesions did not develop in most of the non-hypersensitive animals and the same lesions were found in some animals of the control groups shown to be hypersensitive, Follis concludes that lack of hypersensitivity does not play a part in producing lesions of this type.

Improvement of Forage Plants

THE possibility of improvement of crop plants by hybridization has received a new impulse from the intensive work carried out within recent years in the U.S.S.R., where, among others, various *Triticum-Agropyron* crosses have been carried far enough to indicate possibilities of obtaining constant, perennial forms with advantageous qualities not possessed by annual wheats. L. P. V. Johnson now publishes the results of further crossing experiments between these genera which have been carried out with the view of obtaining improved forage plants, suited to the drier areas of western Canada (*Can. J. Res.*, **16**; 1938). An extensive selection of *Triticum* types has been used as the ovule parents, with *Agropyron elongatum* or *glaucum* as pollen parents; the F_1 hybrids show a predominance of *Agropyron* characters. So far, all crosses with *A. glaucum* have proved sterile, but some fertile types occur amongst the *A. elongatum* hybrids. Russian investigators have already isolated types which are constant, fertile, drought and cold resistant, and productive—all qualities of value in forage plants; also types with high protein content of the grain, which suggests that possibly a plant might be obtained with good forage qualities combined with grain suitable for feeding purposes. In the present experiments some hybrids combine the extensive root system of *Agropyron* with the finer root texture of *Triticum*, a promising feature for growth in an arid zone, and the structure of leaves in some hybrids also suggests lines along which useful results may be obtained. The experiments need to be carried further before definite results can be stated, but the progress report augurs well for the final results.

Direct Oxidation of Soil Humus

MR. C. B. GREENING has published a preliminary account of the use of potassium permanganate for the oxidation of soil humus (*J. Roy. Hort. Soc.*, September 1936). He has now followed it by a more extensive paper (*J. Roy. Hort. Soc.*, **63**, Pt. 12, December 1938). Garden refuse can be oxidized to organic manure by treatment of a heap with permanganate solution (1 oz. per gall. of water). More dilute solutions were applied to lawns, where they stimulated the growth

of grass, eradicated moss, destroyed 'mat' and controlled earthworms. Tomatoes and zonal pelargoniums grew better than normal when treated with still weaker solutions. The action of oxidizing agents might vary with soil type, or with acidity, and such possibilities have still to be appraised. Effects of the treatment have as yet, moreover, been estimated by the unaided eye; but a promising field of practical application is undoubtedly commended for further detailed investigation.

Properties of Broad-Bean Mosaic Virus

A MOSAIC disease upon broad beans was recorded from Japan in 1928, and has since appeared frequently. Characters of the causal virus have been studied by Daiki Murayama (*J. Fac. Agric. Hokkaido Imp. Univ.*, **44**, Pt. 1, pp. 32 and 1 pl., Oct. 1938) who considers it to be similar to the pea virus 2 of Osborn, or pea virus 3, Pierce. The virus extract appears to be of medium virulence, and will not pass even coarse ultra-filters. It is inactivated by heating for 10 min. at 63° C., by ageing for 25 days and by 50 per cent alcohol or 1 per cent formaldehyde acting for 30 min. Extracts were also inactivated when acidified to *p*H 3·0, or when their alkalinity was increased to *p*H 9·5. A precipitation which deprived the extract of its power to infect, occurred under the latter conditions. Symptoms of the disease are given, and a useful table of comparison of the physico-chemical properties of numerous mosaic diseases of leguminous plants also appears in the paper.

New Dermatophyte Fungi

Messrs. K. B. Boedyn and J. A. Verbunt have undertaken the examination of dermatophyte fungi on cases in the Medical School at Batavia since 1935. Their investigations (*Mycopathologia*, 1, Fasc. 3, Sept. 1938) have led to the recognition of three new species of fungi which attack human skin. *Proteomyces variabilis* causes red spots in the trigonum scarpæ of the male. *Favotrichophyton decipiens* attacks hair, causing a white sheath composed of spores of the fungus. *Piedraia javanica* is an interesting ascomycete which forms hard, black nodules upon affected hairs. *Piedraia* is a genus formed by the removal of the conidial form *Trichosporum* from the Fungi Imperfecti, upon the discovery of the ascigerous stage.

The Earth's Crust near New Zealand

K. E. BULLEN has recently made considerable progress in the study of the crustal layers near New Zealand by considering afresh in the light of all the available evidence the Wairoa earthquake of September 15, 1932 (Dominion Observatory, Wellington, W.1, New Zealand, *Bull.*, No. 136; 1938). Taking the S_n reading at Arapuni to be really S^*, an analysis of the P and S readings from all stations indicates an epicentre for the shock at 38·9° S., 177·55° E. and an origin time 13 h. 55 m. 0 s. G.M.T. These are confirmed by P' readings in the opposite hemisphere and macroseismic evidence, and the epicentre is accurate to within 0·2°. The new evidence, along with other considerations, leads the author to a structure from the earth's surface downwards as: sedimentary layer several kilometres thick with P and S velocities 5·0 and 3·0 km./sec. respectively; granitic layer very thin; intermediate layer probably double with a P_g velocity in the upper part of 6·0 km./sec., and the lower part 15 ± 5 km. thick with normal P^* and S^* velocities. This P_g velocity is similar to that observed in California. These results are stated to be tentative, and the results of further work on near earthquakes in New Zealand are awaited with interest.

Design of Small Induction Motors

IN a paper read by Mr. N. F. T. Saunders on January 19 to the Institution of Electrical Engineers, the design of small motors was discussed, and it was pointed out that methods of designing large induction motors are not applicable to machines of less than about one horse-power, called fractional horse-power motors. The author, using analytical methods, establishes simple formulæ for the performance data required in connexion with single-phase induction motors. He then uses correction factors which make the results accurate. He also discusses polyphase induction motors and shows that similar correction factors can be used in their case. These correction factors are based on the conditions usually existing in small motors, which differ appreciably from those found in large motors. For small motors the main factors to be considered are a powerful starting torque and high overload capacity. The modern tendency is to demand silent running, and so the steps necessary to eliminate noise of electrical origin are important factors in the design. As the majority of small machines have to operate at 1,500 r.p.m., that is, they have four poles and run at 50 cycles per second, it is customary to develop standard designs having ratings of an eighth, a sixth, a quarter, a half and three-quarters horse-power with the maximum economy in material. For other speeds the same frames with modified stampings can be used. Several different starting methods for single-phase motors are in use. The most popular at the present time is the capacitor (condenser)-start, the success of which is due to the advance in the technique of electrolytic condensers. An important conclusion arrived at is that the difference between the E.M.F.S at full and no loads will generally produce a marked difference in the iron loss. Hence if the full load efficiency is computed by the 'summation of losses' method the result obtained for the efficiency is too low. For this reason it is recommended that fractional horse-power motors should be tested by a brake method.

Inclination of the Spiral Nebulæ to the Line of Sight

F. G. BROWN showed a year ago that the inclinations to the line of sight of the planes of the extragalactic nebulæ which were more than 2′ in diameter were small, and that the preponderance of small inclinations was due to a systematic orientation of the planes in space. Knox-Shaw examined the objects in the Shapley-Ames catalogue and came to the conclusion that the excess of small inclinations is non-existent. Brown (*Mon. Not. Roy. Astro. Soc.*, **99**, 1; Nov. 1938) now shows that Knox-Shaw excluded an undue proportion of spindles more than 2′ in diameter, owing to the integrated magnitudes of many of them being less than 13·0. For spiral nebulæ not less than 4′ in diameter, the Shapley-Ames catalogue confirms the apparent excess of small inclinations which Brown found by examining the Reinmuth catalogue. In addition, the Reinmuth catalogue shows the persistence of the excess down to 2′ in diameter, and its existence is confirmed by the small nebulæ down to at least 30″ found in Fath's list. It seems certain that Brown has proved his point, and that there is a decided preponderance of small inclinations of the nebulæ under discussion.

Geographical Aspects of Current Problems

ON January 3, Sir Thomas Holland delivered his presidential address to the Geographical Association, on the occasion of its annual conference at the London School of Economics. Taking as his title "The Geography of Minerals", Sir Thomas gave a penetrating analysis of economic and political effects of the unequal distribution of mineral wealth.

Until the Industrial Revolution, little interest had been taken in mineral wealth other than the precious metals, and world development was on an agricultural basis. Political boundaries took no notice of mineral fields. The Industrial Revolution placed a new emphasis on coal and iron, and later the development of steel-making and the more recent discoveries of the uses of alloy steels, together with the expansion of the electrical trades with their great demand for non-ferrous metals such as copper and lead, reoriented the political outlook on minerals. More minerals were actually produced between 1900 and 1925 than during the whole previous history of the world, and although production is still lower in value than that of the field and forest products, it is increasing rapidly, and its effect on political geography is becoming more and more evident.

The possession of, or free access to, a wide variety of minerals is now an essential to the well-being of a great nation, and the unequal distribution of resources, together with the post-War tendency to frustrate the normal or natural movement of raw materials, is at the bottom of much of the present unrest in the world. Both Germany and the Italian Empire are lacking in many of the essential minerals.

It is a striking fact of mineral geography that some seven tenths of the world's iron and steel industry is situated in the countries that border the North Atlantic Ocean. In no other area of the world do coal and iron come together in sufficient quantities ever to give rise to other great steel-producing regions like those of the eastern United States and western Europe. It is this industry which has so largely affected the accessory mineral industries (manganese, chromium, nickel, cobalt, tungsten, etc.). Between them, the United States and the British Empire own about two thirds, and control about three quarters, of the world's mineral industries.

The need for such a wide variety of minerals has meant that the former self-sufficiency of nations in respect of mineral requirements has gone for ever. More than ever before the nations are now interdependent. Here again it is noteworthy, however, that a wide variety of resources occurs in the areas which lie around the North and South Atlantic Oceans. Thus with the British Empire and the United States on friendly terms, and the Atlantic shipping routes under their control, neither Britain nor the United States need have any fears about the supply of any mineral at present considered as vital to industry, whether peaceful or warlike. This rather one-sided position only seems to emphasize the necessity for the interchange of mineral products between the nations, if civilization is not to be destroyed in the revolt of the 'have nots' against the 'haves'.

In a symposium on India, at the same Conference, Sir Thomas Holland contributed a short survey of India's mineral resources, dealing especially with coal and iron, manganese and chromite. Another contribution was from Lord Meston, who described in vivid terms the superimposition of British autocracy, which has converted a congeries of almost medieval peoples into a modern democratic State of 350 million souls, and the difficulties which rapid progress has brought. Dr. L. Dudley Stamp, in suggesting a division of India into physiographic regions, emphasized that the study of modern geography is still in its infancy in India, and that although the universities are now taking a lead, a vast field of work awaits the geomorphologist in utilizing and correlating the mass of material available in the publications of the Geological Survey and elsewhere. In the meantime, it is important that the main physical features of each of the major regions of India should be understood and regarded as an essential background to human and economic geography. Prof. H. J. Fleure finally gave a brief introduction to the study of the nature and origin of some of the Indian peoples.

Another topical item in the Conference was a lecture by Dr. Hilda Ormsby on the 'Sudeten'-lands. Dr. Ormsby also spoke on the problem of Czechoslovakia to the annual meeting of the Institute of British Geographers, which was in session during the same week. Dr. Ormsby presented a clear picture of the geographical background of the recent crisis. Before the Great War, Bohemia was an outpost of Slavdom, forming the industrial core of the Austrian Empire, and fringed with a population of Germans who had filtered across the mountains from the west during many centuries. The Treaty of Versailles allied the Czechs to the Slovaks and Ruthenians, and cut off the 'Sudeten' Germans of the northern and western fringes of the new State from their Austrian motherland. This Bohemian 'salient' of Slavdom became a violent aggravation to the new Reich after the *Anschluss*, thrusting a spear-head into the heart of Greater Germany. The curious nature of many parts of the 'Sudeten' frontier, which, instead of following sparsely populated, forested country, frequently cut across populous areas, was a natural incitement to the reunion of the German-speaking peoples on either side.

The 'post-Munich' frontier, however, cannot undermine the essential geographical unity of Bohemia. The similarity of the industrial occupations on both sides of the highland frontier of Bohemia (the Ore Mountains, Giant Mountains and Sudetes) means that the 'Sudeten' lands are economically tributary to the interior of Bohemia rather than to Saxony, and the fact that the Czechs, for some years, had been removing industry from the 'Sudeten' regions into the heart of Bohemia, has rendered these areas poorer and more liable to unemployment. The new Czechoslovakia, although far more homogeneously Slav than ever before, can scarcely be regarded as anything but a puppet State, held together by the power of Germany. The new German motor-road along the Moravian corridor will sever completely the western and eastern parts of the country, and the main lines of rail communication between east and west have already been cut by the new frontiers in several places.

S. H. BEAVER.

Research in Fuel Technology*

THE growth in size of the annual report of the Fuel Research Board is an indication of the expanding work of this section of the Department of Scientific and Industrial Research, which was established in 1917.

This year special attention is directed to the progress made in the physical and chemical survey of the national coal resources, which was the first task undertaken by the Board. Looking back twenty years, it may surprise some to recall how meagre was the reliable information publicly available about the properties of British coal, considering the magnitude of the industry. Collieries usually had no use for a chemist, and such analytical figures as they possessed were commonly made on a few selected and unrepresentative samples. The larger industrial users often accumulated considerable information about their own fuels, but for their own use only. Conditions might be likened to an unmapped forest traversed by routes known only to local guides. The organization of the survey, which has no counterpart in any other coal-producing country, was not completed until 1932, when all the coalfields were brought under examination. Now complete surveys have been made on sixty-five seams, representing 30,000 million tons of coal, giving detailed and reliable data on one fourth of the proved British coal reserves.

The value of this information grows as the scheme progresses, particularly as regards processes of coal treatment prior to combustion. The more refinement is given to the utilization of coal, the more important it is to know exactly the idiosyncrasies of the raw material. Coals vary in a bewildering degree in properties which vitally affect their uses. Many processes of low-temperature carbonization have broken down on account of swelling or caking power. Again, the quantity and kind of ash or sulphur influences many applications. The behaviour of coal ash is still inadequately treated. There is no standard method of assessing and recording the density of coal ash although this affects the value of coal for many uses—especially as domestic fuels.

* Report of the Fuel Research Board for the Year Ending March 31, 1936. Pp. x+255. (London: H.M. Stationery Office.) 4s. net.

Further work is reported on the problem of dust-proofing coal, which has acquired prominence first in the United States. Coal is dusty to handle, and this dust production is both a domestic and an industrial nuisance. Marked effects in suppressing dust result from spraying oil upon the coal in quantities of the order of 1 gallon per ton. Investigation shows that some 'younger' coals need much more oil than those of older formation. Oil does not produce marked effects on the behaviour on combustion.

It has long been recognized that coal dust can serve as a fuel for internal combustion engines instead of fluid fuels. One of the main obstacles is the problem of getting the solid fuel into, and the ash residue out of, the engine cylinder after combustion, owing to the abrasive action of the latter on the engine parts. In spite of the difficulty, a solution of the problem would have immense value to a coal-rich country like Great Britain, and the task should not be lightly abandoned. Experiments are reported on the wear on cylinder parts produced in a petrol engine when coal ash is fed into the carburettor. The results suggest that by choice of materials it may be possible to reduce the wear to reasonable proportions. A Diesel engine has been installed at the Station and converted for use with coal dust fuel.

Work on the hydrogenation of coal and coal oils is being continued. It is often too easily assumed that tars and oils obtained by carbonizing coal at low and high temperatures are immediately valuable as substitutes for imported mineral oil. This is far from the truth, especially as regards the production of lubricants where molecular structure plays an important part in determining behaviour. By synthesis of hydrocarbons from water gas and polymerization, it is believed that products with satisfactory lubricating properties will be obtained.

These are only a few of the many subjects touched in this report, the 255 pages of which range over the whole field of fuel technology.

H. J. HODSMAN.

Earthing of Electrical Installations to Water-Mains

IT is well known that direct current causes electrolytic corrosion when it leaves a metal conductor or pipe to enter the earth, but there is still a difference of opinion as to whether alternating current has a similar deleterious effect. The very rapid expansion of the use of electricity in Great Britain, for motive power, for domestic applications, for use with radio sets and for agricultural applications has made it advisable that the whole question of earthing be discussed. It is known that electrolytic corrosion proceeds as a rule very slowly, and until large leakage currents have been flowing for many years, in several cases no apparent damage can be detected. A further point that needs discussion is the cause of the electric shocks which are sometimes experienced by workmen when repairing water-mains. It was obvious that some agreement as to the conditions under which earthing-connexions should be allowed was highly desirable.

The whole question was considered by a joint committee of the Institution of Electrical Engineers and the Metropolitan Water Board, as a result of which a draft memorandum on "Earthing to Water-Mains" was issued in December 1926. It was impossible, however, to conclude the negotiations by that committee alone. The rapid expansion of the applications of electricity to factories of all kinds in all parts of Great Britain made the question an urgent one.

In these circumstances, a sub-committee of the Institution of Civil Engineers Research Committee was formed in March 1936, to investigate the existence and extent of damage due to leakage currents, to carry out research work, if necessary, and particularly to obtain mutual agreement on the conditions under which earthing connexions to metal water-pipes might be made and to try, if possible, to formulate a set of regulations. The sub-committee included nominees from the various engineering associations chiefly concerned, and Mr. H. W. Swann, senior electrical inspector of factories of the Home Office.

The sub-committee has been successful in obtaining unanimous agreement on the conditions under which earthing connexions may be made, and has now issued its report*.

The first clause in the report is that an earth-wire connecting an electrical installation to a water-main or water-pipe is to be used only as a safety measure, for the purpose of returning to the source of supply such leakage current as may flow from the electrical installation, for radio currents, or currents from radio-interference suppression devices. In the second clause, it is forbidden to cut or drill or break a water-main or water-pipe. The third clause states that every device used must be of 'approved' design. The fourth clause states that due notice must be given to the water authority concerned when an earth-connexion is made to a buried water-pipe. The fifth clause states that wherever an earth-connexion is made to a water-main or water-pipe on any premises in which a water-meter is installed, a suitable bond must be placed across it by the user, free of expense to the water authority. Finally, if the water supply authority has reason to believe that damage to water-mains or water-pipes is being caused by an excessive flow of electric current through the earth-connexion, it can ask the electricity supply authorities for the district to test the installation in the presence of a representative of the water company. The water company can, if it requires, make its own test after advising the electric supply company.

Post Office installations, other than those for power and lighting services, are specially excluded from the application of these regulations, but are subject to agreement between the authorities concerned.

In the course of its work, the sub-committee came to the conclusion that there are certain other aspects of the problem which could with advantage form the basis of research. Funds have been subscribed for this research by the interests concerned, and the investigation has been undertaken by the British Electrical and Allied Industries Research Association. The programme of research so far approved is as follows: (1) The amount and effect of aggregate leakage currents on water-pipes. (2) The possibility of partial rectification of alternating currents in underground water supply systems, (*a*) at earthing connexions and (*b*) between metal pipes and the soil. (3) The possibility of primary cell effects in water supply systems. (4) The relation of all the above to the question of corrosion. The sub-committee is to be congratulated on its very practical report.

* Regulations for Earthing Electrical Installations to Metal Water-Pipes and Water-Mains. Pp. 6. (London: Institution of Civil Engineers, 1938.) 6*d*.

Social Science at Liverpool

THE publications of the Statistics Division of the Social Science Department of the University of Liverpool provide an admirable illustration of the valuable work which the universities can undertake in the field of social science. The latest addition to the New Merseyside Series ("Handbook of Social Statistics Relating to Merseyside": University Press of Liverpool. 1*s*. net) is no exception and indeed in some matters indicates a further function or responsibility of the university which undertakes such local studies—that of educating local opinion to secure requisite action on the facts disclosed.

This responsibility is very clearly implied in the opening section of this handbook, in which Mr. D. Caradog Jones directs attention to the marked tendency for the population of all four Merseyside boroughs to decline. The rate of natural increase in Liverpool is already less than one half the increase in the early years of the present century, and the rate of increase in Birkenhead is only one quarter of what it then was. He asks the pertinent question whether the serious effect of the anticipated decline upon the demand for houses, for schools, for transport, and upon the need for social services, has been fully appreciated by the local authorities, and, if or whether they are taking steps to deal with a situation that is likely to change rapidly.

In the face of these facts, local authorities will bear a heavy responsibility if on the contrary they continue to legislate on the assumption that the talk about fall in numbers does not concern them, or that if it does there will be plenty of time to set their house in order when the fall begins to take place. None the less, having disclosed the true situation, scientific workers have some measure of responsibility for seeing that the facts are brought to the notice of those concerned with action in a sufficient, definite and convincing manner.

It would not be easy to improve on the lucid but brief presentation which Mr. Caradog Jones uses in this handbook. The section on trade gives an analysis of the trade of the Port of Liverpool in comparison with that of London and the next three most important ports of the United Kingdom. Liverpool showed a greater relative improvement than London in 1936 as compared with 1932 in the value of goods imported, but for exports the position is reversed. Cotton, imported raw and exported as manufactured textiles, holds an outstanding place in the trade of Liverpool and the figures indicated an appreciable increase between 1932 and 1936 in the home demand for manufactured cotton textiles as well as of woollen manufactures.

Statistics of employment alone at first suggest that the position on Merseyside is not discouraging. Actually Merseyside found employment in 1937 for 13,000 more insured workers than in 1929, which is generally regarded as the best all-round post-War

year. This figure, however, represents an increase of only 4 per cent as compared with a 12 per cent increase in Great Britain as a whole, and a 38 per cent increase in unemployment on Merseyside as compared with 16 per cent in Great Britain. Moreover, although the high level of unemployment on Merseyside has not altered very much in the last twelve months, the August figures indicating an increase of less than 2 per cent, the cost of its relief has increased. Unemployment insurance payments in August 1938 were nearly a fifth greater than in August 1937, while unemployment allowances were more than 5 per cent less. Although this position is due partly to the increases in benefit made this year by the Beveridge Committee and the fall in the cost of the means test, to long-standing cases getting work, to final 'cuts' under the 'Standstill Act', and to the revised system of relieving casual labour, the fact that the means test is costing less and benefit more, while unemployment remains much the same, is unexpected.

The cost of outdoor relief decreased between June 1937 and June 1938, but able-bodied unemployed still cost the ratepayers of Merseyside £38,000 a month, £6,200 of which goes to insured workers. Mr. Caradog Jones refers once more to an unfortunate gap in the social services. If an insured person falls sick, he ceases to qualify either for unemployment benefit or for unemployment allowance; he is entitled to sickness benefit, but this takes no account of dependants, and he is therefore frequently driven to apply for poor relief. This is an additional trial to the mind when the body is least able to stand it. Mr. Jones also refers to the absence of anything but poor relief for non-manual workers, such as ships' officers, salesmen and clerical workers who when in work were earning more than £250 a year.

A section on education indicates the difficulties which many teachers in elementary schools in the area have to face as well as the points at which reorganization on the lines of the policy laid down in the Hadow report is most backward. The housing situation is summarized in a further section and particulars of rents and rates are analysed in a final table. The whole handbook, brief as it is, affords an admirable example of the presentation of facts in a manner designed to stimulate appropriate action.

The Highgate Literary and Scientific Institution

Centenary Celebration

ONE of the marked features of the intellectual life of the early years of the nineteenth century was the founding of philosophical, literary or scientific institutions, or societies where lectures could be delivered, discussions held and where libraries could be formed and housed. Many of these institutions, especially those in small towns, have disappeared, or parts of their activities have been absorbed either in the local free library, or in the neighbouring technical college.

Some of the societies have survived and are doing most useful work: amongst these may be mentioned the Cambridge Philosophical Society, the Royal Glasgow Philosophical Society, the Manchester Literary and Philosophical Society, the Leeds Philosophical Society, and the Highgate Literary and Scientific Institution, which has just celebrated its centenary.

Exactly one hundred years ago, on January 16, 1839, a meeting was held at the Gate House Tavern, Highgate, to consider the formation of a society, or, in the quaint words of the invitation card, "for the purpose of forming an Institution designed to excite and cultivate an intelligent interest in the objects of literature and science". The first president was Mr. Harry Chester, who served in that capacity for eighteen years. The Society was evidently welcomed by the inhabitants of Highgate, because at the end of a month the president in his first presidential address was able to state that 110 members and associates had been elected, and that four hundred volumes had been placed in the library, of which three hundred were donations.

The founders were determined that the Institution should be democratic, as is shown by the opening remarks of the president: "This is a voluntary Association of many for the benefit of all and open to all; it is no exclusive Association, to which admission depends on the likes and dislikes of individuals. Here all classes may meet without annoyance to any: and therefore with advantage to all."

In May 1840, the premises the Institution still occupies were rented from the trustees of the estate of Sir John Hawkins, who was an executor, and also a biographer, of Dr. Samuel Johnson. In 1932 it was found possible to purchase the freehold of the property, and in 1936 that of the immediately adjoining property, thus giving the opportunity for further future extensions.

The annual reports of the committee of management of the Institution give a brief story of its activities. In the seventh report (unfortunately, the first six reports are missing) a list of the periodicals in the reading room for the year 1846 is given. It is interesting to note that *Blackwood's*, *Chambers's Journal*, the *Edinburgh Review* and the *Quarterly Review* were mentioned; the remaining periodicals are no longer in existence.

The formation and maintenance of the library has always been regarded as one of the chief duties of the committee of management. The library now consists of more than 11,000 volumes, and includes a considerable number of books of reference. It must be confessed that the scientific side of the library has been allowed to lapse more than it should have done.

The giving of lectures by well-known experts and authorities has always formed an important activity of the Institution. It has been estimated that some 1,700 lectures on the greatest variety of subjects have been given during the past century. Looking back through the annual reports, the development of many of the sciences can be traced by the names of the lecturers and their subjects. "The Proposed Atlantic

Telegraph" (1857), "The Electric Light" (1881), "Polarized Light" (1881) by Mr. William Spottiswoode, then president of the Royal Society, "The Habits of Ants" (1884) by Sir John Lubbock, "Fireworks. Their Chemistry and Mechanics" (1886) by C. V. Boys, "An Evening with the Telescope" (1896) by Sir Robert Ball; and then down to the present time "Large Telescopes" (1937) by the Astronomer Royal, and "Links with the Past in the Plant World" (1938) by Sir Albert Seward. That the artistic and literary side of the Institution has not been neglected may be gathered from the fact that Prof. Henry Morley and Prof. S. R. Gardiner delivered courses of lectures on "Chaucer and the English Writers" and "On the History of England" respectively. Amongst modern writers who have spoken at the Institution may be mentioned Mr. John Drinkwater, Mr. J. B. Priestley and Sir William Rothenstein.

To commemorate the centenary of the Institution, an appeal has been launched to enable some alterations and additions to be made to the old buildings. At the centenary dinner, held at the Criterion Restaurant on January 16, the president (Mr. R. S. Whipple), replying to the toast of "The Institution", which had been proposed by Sir Ian Fraser, mentioned that the sum of £1,327 had been promised—a good beginning, although much more is required. Sir Robert Waley Cohen proposed the health of the visitors, to which the Mayor of St. Pancras and Prof. Allan Ferguson replied. The latter dwelt on the usefulness of institutions such as that of Highgate as centres of intellectual activity.

Additional Evidence of Early Man in America

FURTHER particulars of the Borax Lake site, Lake County, California, on which relics of the Folsom and the earlier Mohave Lake cultures have been found, are made available in a preliminary report to the Carnegie Institution, Washington, by Mr. M. R. Harrington of the South Western Museum, Los Angeles, who was engaged in exploratory investigation there from July 1937 until June 1938.

The bed of Borax Lake is now dry, except for a little saline water at the north-west end. It is surrounded by hills, 300–400 ft. high; but at the south-east it is separated from the Clear Lake basin by a ridge 100 ft. high only. A number of small canyons drain into the lake bed. Their alluvial fans are insignificant, with one exception, on which is evidence of human occupation over a considerable period going back to a time even before the formation of the fan began.

On the surface, Folsom and Mohave points occurred with other elements of the two cultures, as well as a certain archaic type of stemmed projectile point, now named 'Borax Lake' from its relative abundance. With these were a few modern chipped obsidian points. Excavation revealed abundant artefacts at a depth of five and a half feet in dark-coloured soil, and occasional finds in the underlying yellow gravels, sands and clays to a depth of eight feet. No true Folsom or Mohave points were found below the surface, but 'Silver Lake' points of the Mohave complex, Borax Lake points and a 'willow-leaf' type occurred. A keeled type was abundant in the lower part of the deposit with large scrapers and combined chopper-scrapers. Smaller scrapers appeared practically throughout. Metatés, hammer-stones and pestles were found, but no shell or bone implements.

It is suggested that occupation, possibly seasonal, began with the pluvial which followed the Pleistocene ice age, and was abandoned at its close, when desiccation set in.

At the same time exploration and partial excavation of caves in south central Oregon, carried out from 1934 onward by Dr. L. S. Cressman, professor of anthropology in the University of Oregon, would now appear likely to have an important bearing on the date of man's appearance on the American continent. These caves, situated in what is now an extension of the Great Basin of the United States, were produced by the wave action of glacial lakes formed in dammed valleys during the Pleistocene period. On the recession of the ice and the onsetting of gradual desiccation the lakes disappeared, leaving the caves high and dry. One cave explored, for example, is two hundred feet above the valley floor. The caves were then occupied by man for some considerable time. Dr. Cressman has excavated occupational debris to a depth of nine feet or more.

In a preliminary report, also addressed to the Carnegie Institution, on excavations in 1937 at Catlow Valley and in three other localities, which were supported financially by the Institution, it is stated that numerous artefacts were discovered. These included basketry, sandals and black, undecorated potsherds. Faunal bones indicate a change of diet from mainly waterfowl and small rodents in the lower levels to large mammals, deer, bison and mountain sheep, in the upper.

Of two finds of human skeletal remains, one, consisting of a skull and other parts, was embedded about six inches deep in gravels at the north end of the cave and almost under the rear wall. This was about seven feet below the surface of the cave deposits. Absence of clear stratification in the cave invests this discovery with some ambiguity; but Dr. Cressman inclines to the view that the body was deposited in the gravels by wave action, when it was partially decomposed, but still covered with flesh, thus accounting for the unscratched condition of the bones and the circumstances of deposit. This could have happened only when the lake had begun to fall, but storm waters still invaded the cave, that is, not more than 15,000 years ago. It is, therefore, in Dr. Cressman's view, "entirely likely that we have here a representative of early man in the New World".

In two cave sites, one at Paisley and one at Fort Rock, a layer of pumice overlay the earliest evidence of human occupation. The earlier of these, that at Paisley, is assigned to an age of about 10,000 years.

In view of the abundance of fresh water and game in this early period, Dr. Cressman concludes not only that numerous traces of early man will be found in this area, but also that it may have served as the line of advance to Central America of the Asiatic immigrants.

Science News a Century Ago

Birth of Microphotography

IN his paper to the Royal Society on January 31, 1839, entitled "Some Account of the Art of Photogenic Drawing or the Process by which Natural objects may be made to delineate themselves without the aid of the Artist's pencil", Fox Talbot devoted a section to the application of the art to the microscope. "Contemplating the beautiful picture which the solar microscope produces," he wrote, "the thought struck me whether it might not be possible to cause that image to impress itself upon the paper, and thus to let Nature substitute her own inimitable pencil for the imperfect, tedious and almost hopeless attempt of copying a subject so intricate. My first attempt had no success . . . I therefore began a series of experiments in order to ascertain the influence of various modes of preparation . . . the result of these experiments was the discovery of a mode of preparation greatly superior in sensitivity to what I had originally employed. . . . When a sheet of this, which I call 'Sensitive Paper' is placed in a dark chamber, and the magnified image of some object thrown on it by the solar microscope, after the lapse of perhaps a quarter of an hour the picture is found to be completed. . . . On examining one of these pictures, which I made about three years and a half ago, I find by actual measurement of the picture and the object that the latter is magnified seventeen times in linear diameter and in surface consequently 289 times."

The Rhinoceros in the Paris Basin

IN its column of miscellanea, the *Athenæum* of February 2, 1839, said: "On digging the foundations of the new buildings at the Hôtel de Ville in Paris, the workmen, at a depth of seventeen feet, in an alluvial yellow sand, mixed with pebbles, found the right humerus of a rhinoceros, named by M. Cuvier *R. Tichorhinus*. Rhinoceros bones have not been before met with in the Paris basin, although the bones of elephants have occurred. The humerus now alluded to is only four lines less than that of the Cape Rhinoceros, in the museum of the Jardin du Roi; it is sixteen lines less in length than the single-horned rhinoceros of India, but its circumference exceeds each by one inch. M. Cuvier's opinion thus appears to be confirmed as to the relative size of the two-horned fossil rhinoceros which he thought was of shorter and thicker proportions than the recent animals."

Preservation of Bodies for Dissection

THE *Lancet* of February 2, 1838, contains the following information: "M. Gannal has recently published a pamphlet on the embalming of bodies and the preservation of specimens of natural history and morbid anatomy. After numerous trials with the salts of alumina and various other substances M. Gannal has elected the sulphate of alumina as being at once the most efficacious and the cheapest material that can be employed. Two pounds of the sulphate of alumina dissolved in a quart of water are sufficient to preserve a dead body in a state of freshness for at least two months. If the weather be very hot it will be necessary to employ the fluid in a greater degree of concentration. The solution of alumina is simply injected into the vessels of the subject, and the cost of preservation does not exceed tenpence for each body."

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **208**, 22–56, Jan. 3, 1939).

A. CHEVALIER: Species, varieties and hybrids of cotton, especially the cotton of Asiatic origin cultivated in tropical Africa. These Asiatic cottons are not of commercial importance, having been displaced by American cottons.

F. ENRIQUES: The characteristic property of irregular algebraic surfaces.

F. ROGER: Critical varieties of systems of functions of many variables and the critical families in the calculus of variations.

H. MILLOUX: A new inequality in the theory of meromorph functions.

P. VAILLANT: Passage of current through copper iodide. A cell consisting of 'iodized' copper foils has a conductance of some tenths of mhos, which varies between wide limits with intensity and duration of current and the temperature.

A. RABINERSON and M. PHILIPPOV: Emission of ultra-violet rays in the course of coagulation [of hydrophobic sols such as $Fe(OH)_3$ and V_2O_5 and of hydrophilic sols such as sodium oleate].

P. CASTEL: Preparation of ortho-arsenic acids of thorium.

C. PRÉVOST: Contribution to the study of the Raman wave numbers of the ethylenic bond.

O. K. HOUO: An α-γ-biethylenic alcohol.

P. GAUBERT: Mobile rings produced in anisotropic drops of the nematic phase by the addition of a substance possessing [optical] rotatory power. The method provides a means of detecting optical rotatory power and its sign; 0·1 mgm. or less of the substance is required.

H. GARRIGUE: Measurements of radioactivity and temperature in the region of Lyngmarksbræen (northern Greenland).

J.-L. VIDAL: Role of transpiration and of carbon dioxide in the etiology of calcium chlorosis. Although lack of soluble iron may be the fundamental cause of chlorosis, carbon dioxide in the soil and intense transpiration are other factors.

E. MIÈGE: Influence of altitude on the biology of the potato. Altitude and also the use of artificial cold increase the vitality and productivity.

E.-F. TERROINE and MLLE. T. DEVRIENT: Degree of oxidation of the waste products of protein catabolism as a function of their importance and of their origin.

MME. S. BELLUC, J. CHAUSSIN, L. LESCOEUR and MME. T. RANSON: Action of Vichy water treatments on the urinary elimination of the normal man; modifications produced in the metabolism of phosphates.

Brussels

Royal Academy (*Bull. Classe Sci.*, **24**, No. 10, 1938).

L. GODEAUX: (1) Algebraic surfaces the canonical system of which is composed of at least one involution having only a finite number of unit points. (2) Involutions of genera one belonging to an algebraic surface.

J. E. VERSCHAFFELT: (1) The application of the principles of thermomechanics to the conduction of heat. (2) The application of the principles of thermomechanics to fluids in movement.

E. DE WILDEMAN : Movements of certain organs of higher plants (2).

H. FREDERICQ : The mechanism of the 'secondary refractory period' of the cardio-inhibitory apparatus of the tortoise.

S. GOLAB : Some points of the geometry of ensembles.

P. CAPRON and M. DE HEMPTINNE : Concentration of the carbon isotope of atomic weight 13. By a battery of Hertz pumps a sample of methane was obtained containing 50 per cent of carbon 13.

G. BALASSE : Continuous spectrum of atomic hydrogen.

P. DENIS : Mitraspecine, a new alkaloid from *Mitragyna speciosa* Korthals.

Budapest

Hungarian Academy of Sciences, December 12.

A. BUZÁGH : Structure of adsorbed layers and adhesion in liquids.

G. RADOS : Further data on the theory of unitary substitutions.

J. MAREK, O. WELLMANN and L. URBÁNYI : Changes in the composition of the blood of a young pig, induced by food containing different kinds of minerals.

N. MAUTHNER : (1) Synthesis of a new glucogallic acid. (2) Synthesis of 6-oxy-8-methoxycoumarin.

L. BOGSCH : Contribution to the knowledge of *Ervilia pusilla* and *Ervilia miopusilla* races.

A. ERDÉLYI : Eigen-values of the Sturm-Liouville boundary problems.

I. LIPKA : Nets of conic sections.

Cracow

Polish Academy of Sciences (*C.R.*, December 1938).

K. DZIEWOŃSKI, Z. ALBIN and P. TRZĘSIŃSKI : Study of pyrene.

J. TOKARSKI : Petrography of tufa elements of the sub-Carpathian salt-bearing regions.

MLLE. J. DYAKOWSKA : The interglacial formation of Ściejowice in the neighbourhood of Cracow.

H. SZARSKI : Results of removal of the thymus in anuran batrachians. Frogs and toads live after this operation for more than ten months without food ; the gonads develop normally.

Dublin

Royal Dublin Society, December 13.

V. C. BARRY : Constitution of laminarin : isolation of 2 : 4 : 6 : trimethylglucopyranose. Attempts made to extract laminarin sulphate from *Laminaria* fronds with dilute oxalic acid gave laminarin which contained very little combined sulphate. Laminarin was converted to a triacetate which on methylation was converted quantitatively to trimethyllaminarin. Hydrolysis of trimethyllaminarin gave a crystalline trimethylglucose which was identified as 2 : 4 : 6 : trimethylglucopyranose. Laminarin, therefore, is linked from the aldehydic carbon of one glucose unit to the third carbon of the next unit. Examination of its properties suggests that laminarin consists of a chain of β-glucopyranose units bent into a spiral form.

J. S. BARLEE : A note on the waxy secretion of some glaucous cedar leaves. Two cedars of the same variety, *Cedrus atlantica* var. *glauca*, were compared. One grown in a city atmosphere was very stunted and weakly, being but 1·63 m. high. The other tree, 2½ miles out of town, was well developed and healthy, about 7 m. high. Each tree was more than twenty years old. It was suggested that the stunting of one tree was due to the blocking of the stomata of the leaves by soot ; and examination of sections of the leaves by transmitted light indicated that the stomata were occupied with an opaque material, which also covered the surface of the leaves. This substance, however, was seen to be pure white. It gives the whole tree its characteristic silver colour, and was shown to be a wax. It is apparently a normal secretion, for it was found on the healthy as well as the stunted tree.

Tokyo

Imperial Academy (*Proc.*, **14**, No. 8, 325–357, November 1938).

KENTARO YANO : The new theory of Einstein and Bergmann.

KOSAKU YOSIDA and SHIZUO KAKUTANI : Application of mean ergodic theorem to the problems of Markoff's process.

ATUO KOMATU : Surfaces of cell spaces.

TSURUSALURO TAKASU : A conformal geometric generalization of geodetic lines (2).

HIDEO MATSUYAMA : Thermal analysis of the second order reaction.

SIN'ITI KAWAI and NOBORU SUGIYAMA : Researches on egonol. Syntheses of the two egonol degradation products—dihydro-coniferyl alcohol and styraxinolic aldehyde.

HISAKATSU YABE and TOKIO SHIKAMA : A new Jurassic mammalian from South Manchuria.

Vienna

Academy of Sciences, November 10.

A. KAILAN and O. ALBERT : Velocity of catalysed hydrogenation. The velocity of hydrogenation of aliphatic acids in the presence of a nickel catalyst is determined. Acids with an even number of carbon atoms have a higher velocity of hydrogenation than the neighbouring acids with odd numbers of carbon atoms.

F. WESSELY and S. WANG : Occurrence of adonitol. The pentahydric alcohol adonitol has been found in the Chinese drug chei-hou (the root of *Bupleurum falcatum*). The only other known natural source of this compound is *Adonis vernalis*.

R. WIESNER : Radium content of Algæ. Both sea- and fresh-water Algæ are found to be rich in radium, the content of *Zygnema*, for example, being as great as that of the granites richest in radium. Fresh-water Algæ have 10–100 times the radium content of sea-water Algæ.

R. PITTIONI and E. PREUSCHEN : Excavations in 1937 and 1938 in the pre-historic mining region of Kelchalp at Kitzbühel.

November 17.

K. GRAFF : Colorimetric measurement of stars down to the 6½ magnitude visible in Europe.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, January 30

BIRKBECK COLLEGE CHEMICAL SOCIETY, at 6.—Prof. S. Sugden, F.R.S.: "Neutrons and Chemistry".*

Tuesday, January 31

LONDON SCHOOL OF ECONOMICS, at 5.—Dr. L. Dudley Stamp: "The Fertility of the Land in Britain".*

COURTAULD INSTITUTE OF ART, at 5.30.—Dr. Herbert Chatley: "Ancient Chinese Astronomy" (succeeding lectures on February 7, 14, 21 and 28).*

Thursday, February 2

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.30.—L. W. Hayes and B. N. MacLarty: "The Empire Service Broadcasting Station at Daventry".

Friday, February 3

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—E. J. Wayland: "Soil Erosion in Uganda".

ROYAL INSTITUTION, at 9.—Sir Charles Bressey: "Bigger London or Better London".

Saturday, February 4

GILBERT WHITE FELLOWSHIP (in the Hall of the Art-workers Guild, 6 Queen Square, W.C.1), at 3.—Dr. J. Ramsbottom: "Toadstools and Their Ways".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

UNIVERSITY READER IN BIOCHEMISTRY at Guy's Hospital Medical School—The Academic Registrar, University of London, Senate House, W.C.1 (February 1).

LECTURER IN PHYSICS AND CHEMISTRY and LECTURER IN ENGINEERING SUBJECTS in the West Hartlepool Technical College—The Chief Education Officer, Education Offices, Park Road, West Hartlepool (February 3).

BIOCHEMIST in the Department of Animal Husbandry of the Royal Veterinary College—The Bursar (February 4).

ASSISTANT WOMAN LECTURER IN NATURAL HISTORY in the Froebel Educational Institute Training College for Teachers, Grove House, Roehampton Lane, London, S.W.15—The Principal (February 5).

ASSISTANT (grade III) in the Geological Survey and Museum, Exhibition Road, South Kensington, S.W.7—The Director (February 7).

HEAD OF THE CHEMISTRY DEPARTMENT in the Rutherford Technical College—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne (February 11).

LECTURER IN CHEMISTRY in the West Ham Municipal College, Romford Road, Stratford, E.15—The Principal (February 14).

PROFESSOR OF MEDICINE in the University of Otago—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (March 22).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1812 (3450): Variations of Shear Stress in Thin-walled Tubes under Torque. By D. Williams and J. Taylor. Pp. 7. 1*s.* 3*d.* net. No. 1831 (3109): Simple Formulæ for the Fundamental Normal Frequencies of Cantilevers. By Dr. P. B. Walker. Pp. 20. 3*s.* net. No. 1832 (3556): Critical Reynolds Numbers of Spheres in the Compressed Air Tunnel. By A. Fage and D. H. Williams. Pp. 8. 1*s.* 3*d.* net. No. 1833 (3534): Notes on Longitudinal Stability at Low Speeds. By R. H. Francis and Dr. G. E. Pringle. Pp. 6. 1*s.* net. No. 1837 (3537): A Comparison of Aileron Control on Tapered Wings with Straight Leading Edge and Straight Trailing Edge. By H. B. Irving and A. S. Batson. Pp. 8. 1*s.* 3*d.* net. No. 1839 (3487): A Simplified Theory of Wing Flutter. By Dr. A. G. Pugsley. Pp. 10. 1*s.* 6*d.* net. (London: H.M. Stationery Office.) [2212

Thirty-sixth Annual Report, 1937–1938, of the Imperial Cancer Research Fund. Pp. 40. (London: Imperial Cancer Research Fund.) [2812

Proceedings of the Royal Society of Edinburgh. Session 1938–1939. Vol. 59, Part 1, No. 1: The Molecular Spectra of the Hydrogen Isotopes. 1: Application of the Rotating Vibrator Model to the States of D_2. By Dr. Ian Sandeman. Pp. 14. 1*s.* 3*d.* Transactions of the Royal Society of Edinburgh. Vol. 59, Part 3, No. 21: The Life-History and Development of *Agriolimax agrestis* L., the Gray Field Slug. By Dr. Robert Carrick. Pp. 563–597. 4*s.* 6*d.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [2812

Catalogue of the Twenty-ninth Annual Exhibition of Scientific Instruments and Apparatus, held at the Imperial College of Science and Technology, South Kensington, London, S.W.7, January 3rd, 4th and 5th, 1939. Pp. 239+lxxxviii. (London: Physical Society.) [2912

Education in Citizenship, by Spencer Leeson; Education for World Citizenship, by Laurin Zilliacus. Pp. 26. (London: Association for Education in Citizenship.) 6*d.* [3012

National Smoke Abatement Society. Ninth Annual Report, 1938–9. Pp. 30. Britain's Burning Shame. Pp. 32. 2*d.* (London: National Smoke Abatement Society.) [3012

Royal Commission on Safety in Coal Mines. Report. (Cmd. 5960.) Pp. xxxii+520. (London: H.M. Stationery Office.) 7*s.* 6*d.* net. [3012

Report of the Commissioner for the Special Areas in England and Wales for the Year ended 30th September 1938. (Cmd. 5896.) Pp. vii+120. (London: H.M. Stationery Office.) 2*s.* net. [61

Report of the Commissioner for the Special Areas in Scotland for the Period 1st September 1937 to 30th September 1938. (Cmd. 5905.) Pp. viii+88. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [61

Research in the Iron and Steel Industry. (The 10th Gluckstein Memorial Lecture, 1938.) By Dr. W. H. Hatfield. Pp. 29. Opium. (Twenty-first Streatfeild Memorial Lecture, 1938.) By John Ralph Nicholls. Pp. 35. (London: Institute of Chemistry.) [61

Other Countries

Government of Iraq: Ministry of Economics and Communications. Iraq Geological Department, Publication No. 1: Water Supplies in Iraq. By W. A. Macfadyen. Pp. iii+206+viii+19 plates. (Baghdad: Government Press.) 250 fils; 5*s.* [2212

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 45: Technological Reports on Standard Indian Cottons, 1938. By Dr. Nazir Ahmad. Pp. iii+104. (Bombay: Indian Central Cotton Committee.) 1.8 rupees. [2812

Egyptian University. Bulletin of the Faculty of Science, No. 16: Notes on the Anatomy of the Egyptian Kite, *Milvus ægyptius* Gm. By A. H. Al-Hussaini. Pp. 42+2 plates. (Cairo: Egyptian University.) [3012

Department of Science and Agriculture, Jamaica. Bulletin No. 16: A Survey of the Yields of Sugar Cane in Jamaica, 1936–1937. Report by H. H. Croucher. Pp. ii+36. 6*d.* Bulletin No. 17: Soil Erosion and Conservation in Jamaica, 1937. By H. H. Croucher and C. Swabey. Pp. 20. 6*d.* (Jamaica: Government Printing Office.) [3012

City of Durban: Durban Museum and Art Gallery. Annual Report for Municipal Year 1937–1938. Pp. 12+4 plates. (Durban: Durban Museum and Art Gallery.) [61

Observatoire de Zi-ka-wei. Notes de météorologie physique, Fascicule 8: Étude de la vapeur d'eau, de l'oxygène et des poussières contenues dans l'atmosphère, à l'Observatoire de Zô-sè. Par le R. P. Pierre Lejay. Pp. ii+40. (Zi-ka-wei: Observatoire de Zi-ka-wei.) [61

Colony of Mauritius: Department of Agriculture. Eighth Annual Report of the Sugarcane Research Station, for the Year 1937. Pp. 62. (Port Louis: Government Printer.) 80 cents. [61

Report of the Aeronautical Research Institute, T'ai-kû Imperial University. No. 170: The Moment of the Fluid Pressure acting on a Flat Plate in a Stream between Two Parallel Walls and some Allied Problems. By Susumu Tomotika. Pp. 473–551. (Tokyo: Kagyô Tosho Kabushiki Kaisha.) 95 sen. [61

Field Experiments on Sugar-Cane in Trinidad: Annual Report for 1938. By P. E. Turner. Pp. 121. (Trinidad: Sugar-Cane Investigation Committee.) [61

The Sherbro of Sierra Leone: a Preliminary Report on the Work of the University Museum's Expedition to West Africa, 1937. By H. U. Hall. Pp. v+52. (Philadelphia: University Press of Pennsylvania.) [61

Comité National français et Comité National marocain de Géodésie et Géophysique. Années 1933, 1934, 1935, 1936. Compte rendu publié par le Secrétaire Général du Comité français, G. Perrier. Pp. 408. (Paris: Secrétariat Général du Comité français.) [61

Catalogues, etc.

Annotated Catalogue of Works on Chemistry, Pure and Applied. (Sotheran's Price Current of Literature, No. 857.) Pp. 176. (London: Henry Sotheran, Ltd.)

Die Askania-Warte. Nr. 14, November-Dezember 1938. Pp. 24. (Berlin-Friedenau: Askania-Werke A.G.)

Calendar for 1939. (London: The *Chemical Trade Journal*).

The Book of Dunns Farm Seeds, 1939. Pp. 68. (Salisbury: Dunns Farm Seeds, Ltd.)

Lettres, Arts, Sciences. Pp. 32. Enseignement du second degré: Écoles primaires supérieures, Lycée et Collèges. Pp. 24. (Paris: Libr. Delagrave.)

Der vordere Orient vom Altertum bis zur Neuzeit: Geschichte, Kulturgeschichte, Religion, Sprache, Literatur, Kunst. (Antiquariatskatalog Nr. 728.) Pp. 176. (Leipzig: Gustav Fock, G.m.b.H.)

The Hammond Organ Bulletin. No. 1, January. Pp. 6. (London: Boosey and Hawkes, Ltd.)

A Catalogue of Books and Periodicals on all Classes of Zoology. (No. 557.) Pp. 140. (London: Bernard Quaritch, Ltd.)